AUGUST 1957

Power Engineering

At Start-Up, Test Steam Line Cleanness This Way 67
Extend Turbine Blade Life With Metal Spray 68
What You Should Know About Gas Pressure Regulators 70
Costs of Two Methods of Driving a Shaft 73
You Can Test Transformer Protection Before You Buy 76
Helium Gas Turbine Nuclear Plants for H-T Cycles 78
Think You Need More Air Compressors? 82
Aluminum Jackets Bayway Lines in Steam-Oil Swap 83
What It Costs To Modernize Small Power Plants 84
How To Fireproof Your Fuel Tanks 91
Big Job-Engineered Heat Pumps Make the Big Savings 92
Mechanical Coal Sampling . . . Is It Reliable? 94
Not an Electrical Feeder in Sight – No Clutter 97
NAPE Stresses Education at Diamond Jubilee 98
Basic Facts About Transformers for Maintenance Men 102

REGULAR DEPARTMENTS

Engineers' Preview 3
What They Tell Us 6
Helpful Bulletins 25
Construction News 44
Equipment News 46
News Reel 88
Power Engineering Handbook 102
New Engineering Books 118
Catalog Library 123
Reader Service Post Cards 123
Advertisers' Index 138
Circulation of This Issue 41,630

Hardened, Honed Seats

for tough throttling service

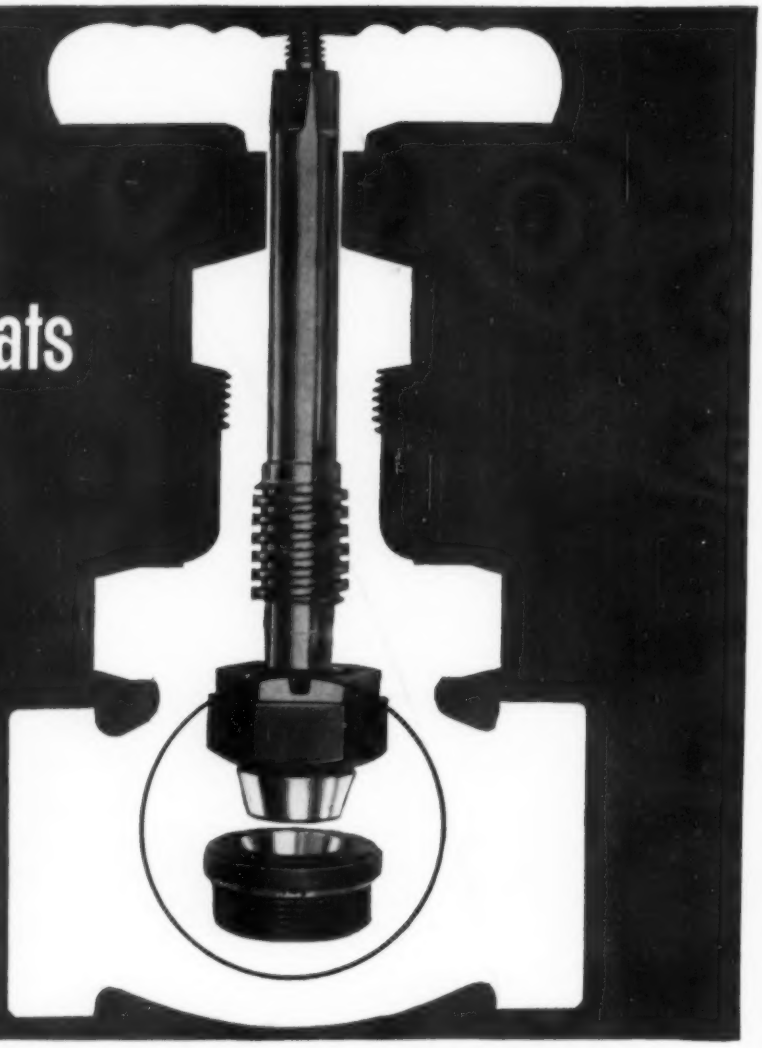

Fig. No. 558, bronze globe valve, 200 lbs. WSP, @ 550°F., 400 lbs. WOG, non-shock

A plug-disc and seat so hard they can crush scale between them and still close tight. A stem that absolutely will not gall or seize. The combination is in a rugged bronze valve designed for tough throttling service . . . the OIC 558!

Both plug-disc and seat are stainless steel, heat-treated to more than 500 Brinell hardness. Their seating surfaces are ground and *honed* to an accurate, smooth, bearing finish. The stem is OIC *alloy-40*, a sturdy bronze which won't gall or seize.

Remember, in throttling service a valve's stem, plug-disc and seat must withstand the most abusive wear. Rely on the toughness designed into this OIC line to give you extra-long service. Specify the modern 558 where you need bronze globe valves for throttling.

Write for Form No. 1001 which describes this valve along with the entire OIC 500 line, including composition disc and spherical disc globes, angles and check valves.

Call your OIC Distributor.

THE OHIO INJECTOR COMPANY • WADSWORTH, OHIO

P-507

VALVES | **FORGED & CAST STEEL, BRONZE & IRON, LUBRICATED PLUG VALVES**

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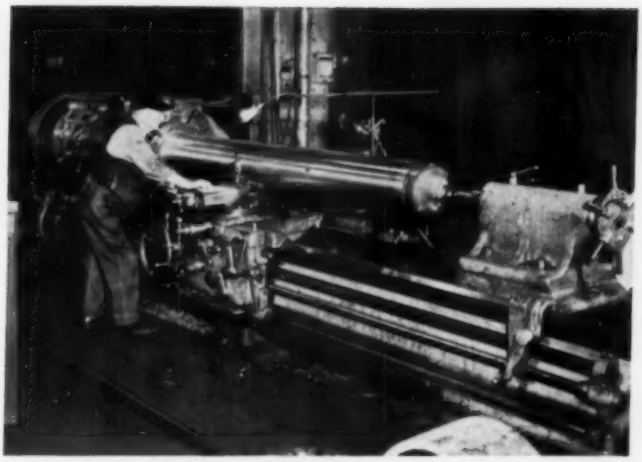
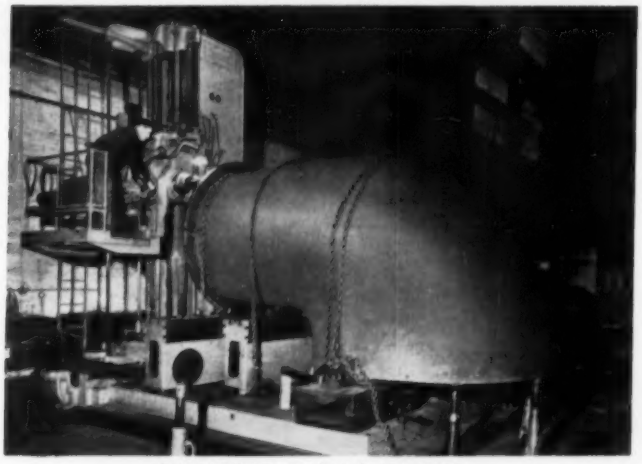


Machining stainless steel pressure vessel for nuclear installation.

Drilling bore in flange for power piping.



Drilling bolt holes in cast fitting for water service.

MACHINING at Pittsburgh Piping

another P. P. & E. service which contributes to *Improved* HIGH-TEMPERATURE HIGH-PRESSURE PIPING

Corrugated tangents and creased bend fabricated in Pittsburgh Piping shops. The flexibility of this type of piping is advantageous in suitable applications, making possible the use of shorter, more compact lines.

The machining of components for high-pressure, high-temperature piping, pressure vessels, and related equipment requires special skills and specialized equipment. Pittsburgh Piping has the trained, long-experienced machine operators and the proper equipment for this work. Machining is an important phase of our complete service in the shop fabrication and field erection of piping systems for central stations, processing plants, and nuclear power installations.

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PP-22

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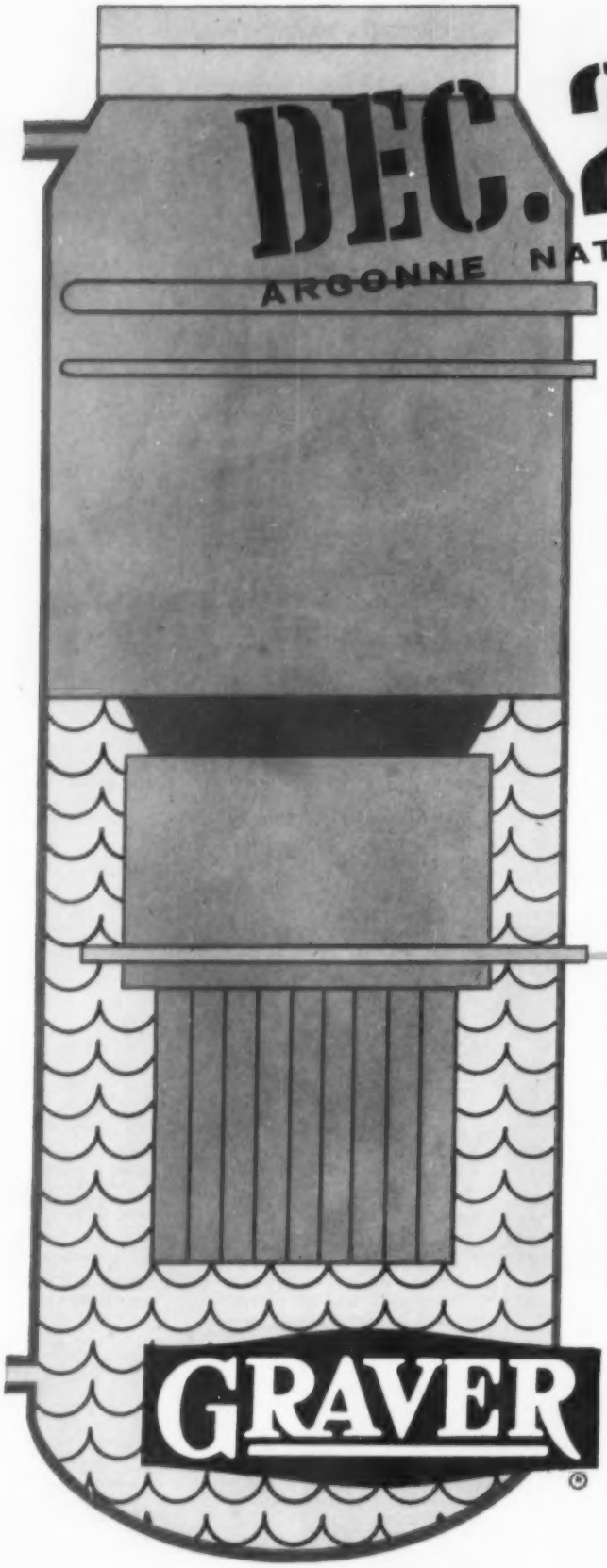

A date long to be remembered as a milestone in our expanding nuclear technology. On this day, after many months of scientific investigation, planning and construction, the Experimental Boiling Water Reactor reached full power generation.

This reactor, dedicated to the peace and prosperity of mankind, employs a promising new system for the generation of power from nuclear fuels. Operating on a direct steam cycle, it eliminates the need for intermediate heat exchangers and permits operation of the reactor at a pressure no higher than that required for the turbine generator system.

The primary advantage of this "direct-boiling" reactor is the simplicity of the reactor itself and associated power system. In the simplest terms, the reactor is operating as a boiler. Nuclear energy liberated by a chain reaction heats the uranium metal fuel plates, which, in turn, transfer the heat to the water around them. This is diagrammatically shown in the sketch at left. Part of the steam produced, at the proper pressure, is used for the generation of electricity.

The continuous removal of corrosion products from the water in the reactor vessel is the function of the reactor purification system. This all-stainless steel system removes water from the bottom of the reactor and, after cooling, delivers it to the ion exchange columns. The resin exchange beds remove all ionic impurities. Purified water is then pumped back with the feedwater. This ion exchange system consists of two Graver rubber-lined, mixed-bed units, 20" dia. x 84" high, having four inches of lead shielding and weighing about 18,000 pounds each.

Graver also furnished a second separate ion exchange, or demineralizing, system for the treatment of makeup water. That system has two rubber-lined, mixed-bed units, 24" dia. x 9'0" high, and a complete regeneration arrangement.

Although only a small part of an important project, both of these systems had to meet the extremely high requirements of engineering, construction and performance required in all Atomic Energy work — another example of Graver's high engineering standards for water treatment equipment.

Industrial Department: I-311

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Division of Graver Tank & Mfg. Co., Inc.

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NBP BPA

PUBLISHED SINCE 1896 FOR POWER ENGINEERS IN PRIVATE AND PUBLIC UTILITIES AND INDUSTRIAL PLANTS

ENGINEERS' PREVIEW

PULSE-TAKING of the engineering profession is also going on apace through the National Society of Professional Engineers which has just turned up some fresh facts about salaries and other job conditions.

Studying 6,407 engineers employed by consulting firms — as distinct from owners and partners — NSPE finds that median monthly salaries for eight grades of engineer employees are as follows: $358, $433.55, $504.40, $582.12, $657.70, $768.89, $947.02, and $987.54. These figures do not include payment of bonuses — a common practice in consulting firms.

Most of these engineers worked a 40-hr week, but 5.8 per cent worked less, and 28 per cent worked from 41 to 44 hours. "Fringe" benefits festoon the picture.

The Society's report is available at $1 a copy, from 2029 K St, NW, Washington 6, D. C.

SOCIETE Coöperative Electro Nucleaire has announced in Brussels the signing of a formal contract with Westinghouse Electric International Co, for an 11,500-kw atomic power plant which will provide Belgium with electrical energy by the end of 1959. The unit will embody the latest advances in pressurized water reactor design and will utilize slightly enriched uranium oxide as fuel. It will be installed near Brussels at Mol, center for the country's atomic research. Power generated by the plant will be delivered to the "grid" or electrical transmission system that serves the entire country.

LOOKING over the engineering educational scene with an appraising eye, the Engineers Joint Council reports that the 1956–57 school year drew one of the largest freshman engineering classes on record (second only to the 1946 class). EJC finds that in the main our engineering colleges have comfortably absorbed this bumper crop of would-be engineers, and that there is no evidence that qualified students are being turned away. The Council's survey, Engineering Education Facilities, 1957 (report 104) is available at 25 cents a copy, from Engineers Joint Council, 29 W 39th St, New York 18, N. Y.

BIGGEST TURBINE GENERATOR yet to be contracted by the Elliott Co is a 33,000-kw unit for Corn Belt Power Cooperative of Iowa. Elliott's Ridgway Division has also been awarded a contract for two 42,105-kva, 128.6-rpm vertical hydraulic turbine-driven generators for installation at Fort Peck Dam, Garrison District, Corps of Engineers. Cost is $1,826,421.

ROBERT F. McCAW has joined the POWER ENGINEERING editorial staff as an associate editor. This adds another powerful member to the expanding POWER ENGINEERING force.

McCaw has had broad and varied experience in both public utility and industrial power engineering fields. Typical of the jobs he has held are those as division engineer, chief electrical engineer, construction superintendent, assistant plant manager and facilities administrator, with such concerns as Interstate Power Co, General Cable Corp, Radio Corporation of America and National Broadcasting Co.

Associate Editor
Robert F. McCaw

Before the war he managed his own electrical contracting business and during the war was electrical superintendent, chief electrical engineer or project manager on four major defense projects.

He is a native of Missouri, and was educated at the Missouri School of Mines (Missouri University), from which he received a degree of B.S. in Electrical Engineering, an ROTC commission in the Corps of Engineers and later an honorary professional degree. He is a member of: ASME; AIEE; NSPE; AIPE (charter member and national vice-president); Theta Tau engineering fraternity; Incorporated Plant Engineers (England); and International Conference on Large Electric Systems (CIGRE, France). He is also a civilian consultant to the Department of Defense.

UNDERLINING the dramatic growth of the Province of Ontario is the recent announcement by Ontario Hydro of its plans to increase the installed capacity of its Richard L. Hearn Generating Station in Toronto to 1,200,000 kw, making it one of the world's largest thermal power plants.

This increase from the present 400,000-kw capacity will be made by the addition of four 200,000-kw units and will be one of the largest extensions ever made to a power plant. The new addition to the station will be designed and constructed by Stone & Webster, who built the existing Hearn power plant.

75th BIRTHDAY of the Wm. Bros Boiler & Mfg Co is being celebrated by a change in corporate name. The firm will now be known as Bros Incorporated.

CHANGES AT HARVARD University in engineering personnel have been announced effective September 1. Prof. Harvey Brooks, who is Gordon McKay Professor of Applied Physics, will become the new Dean of Engineering and Applied Physics. He succeeds John H. Van Vleck, who plans to resume his research at Harvard in mathematical physics. Albert Haertlein, who is Gordon McKay Professor of Civil Engineering, will continue as Associate Dean of Engineering and Applied Physics.

NAME of Union Carbide and Carbon Corp has been shortened to Union Carbide Corp, effective May 1. Names of three divisions of Union Carbide have also been changed. Carbide and Carbon Chemicals Co has become Union Carbide Chemicals Co; Linde Air Products Co is changing its name to Linde Co; and Carbide and Carbon Realty Co will be known as Union Carbide Realty Company.

U. S. COAST GUARD and the Union of South Africa are among the latest customers for solar energy put to work. Both have ordered full-size solar energy converters from Hoffman Electronics Corp of Los Angeles.

The Coast Guard installation, a converter mounting over 300 silicon solar cells, will supply about 13 watts to be used to power a flashing light in Los Angeles Harbor. Two solar converters for South Africa will be evaluated there for use in remote telephone lines.

$50,000 for fire protection is an important part of the picture for the U. S. section of the St. Lawrence Power Dam. Carbon dioxide systems will protect the 16 air-cooled 60,000-kva generators, oil storage, service and purifier rooms, and two high voltage cable pump rooms. Supplier of these systems is Walter Kidde & Co.

For the generators, the layout will consist of four electrically-operated systems, each using 53 75-lb cylinders of the fire-smothering gas. The systems are interconnected so that three banks of cylinders can act as a reserve to back up the fourth. Each system has switches and trips built into its piping that are actuated by the passage of gas. When thrown, they secure generator ventilation, shut off all electrical power, sound alarms.

A NEW CODE for recruiting practices and procedures to be used by employers seeking to attract engineering seniors, has been adopted by both the American Society for Engineering Education and the Midwest College Placement Association. It is designed to prevent the irregularities and abuses that have developed and is available from W. Leighton Collins, Secretary, ASEE, University of Illinois, Urbana, Ill. Price is 25 cents a copy, or 15 cents a copy in lots of 50 or more. Price for five is $1.

EDWIN J. SCHWANHAUSSER, vice chairman of the Worthington Corp, recently was awarded an honorary Doctor of Engineering degree by his alma mater, Stevens Institute of Technology. Mr. Schwanhausser has been closely connected with the power engineering field all his life. While an undergraduate in college, he worked summers at Worthington's Harrison plant. When he graduated with a degree of Mechanical Engineering in 1915, he joined the company permanently. As superintendent of erection, he installed the condensers for the first unit of Hell Gate Station in 1922. In 1929, he became manager of the Buffalo Works. He was made vice president in 1939, president in 1955 and vice chairman in 1957.

Edwin J. Schwanhausser

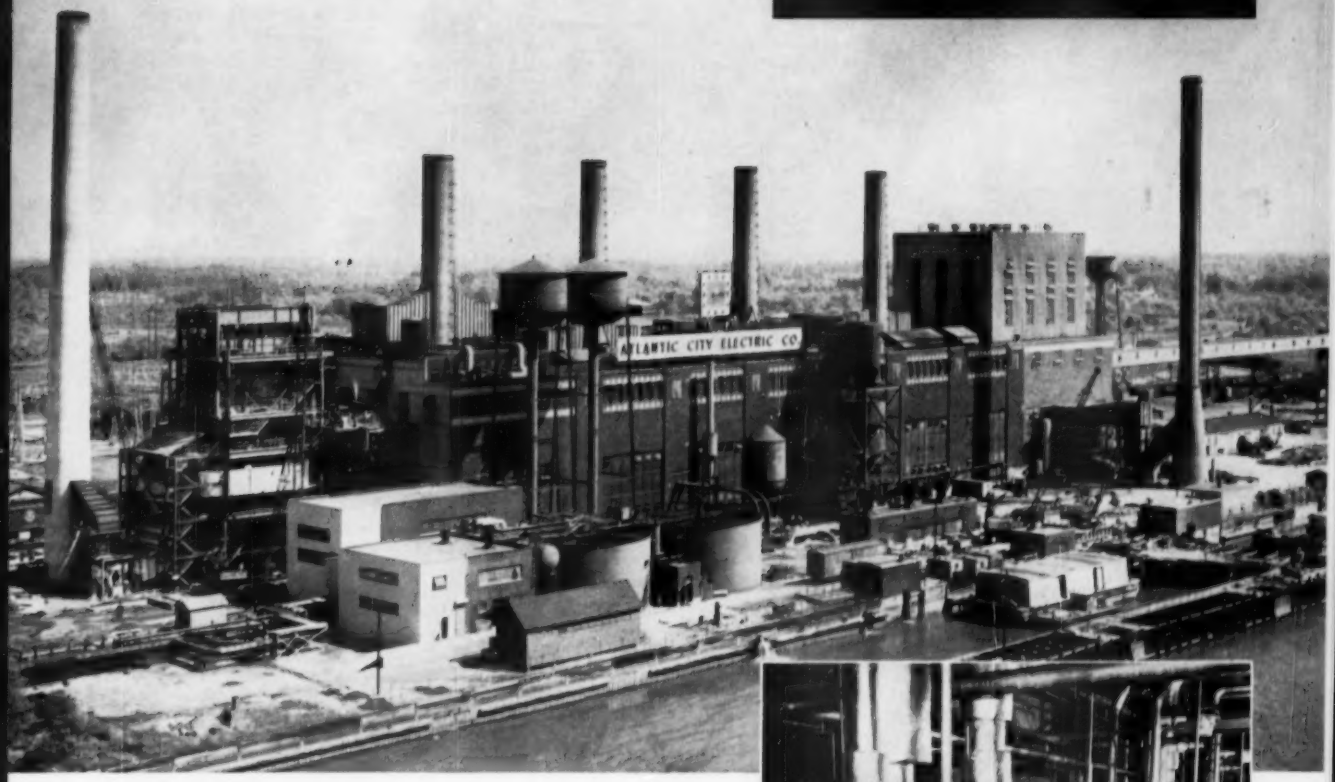
MOST COMPREHENSIVE survey of the engineering profession ever undertaken is the objective behind the appointment of a joint task group from the Engineers Joint Council and the Engineers' Council for Professional Development. Chairman for the new committee is Dr. Joseph W. Barker, chairman of the board of the Research Corp and president of EJC.

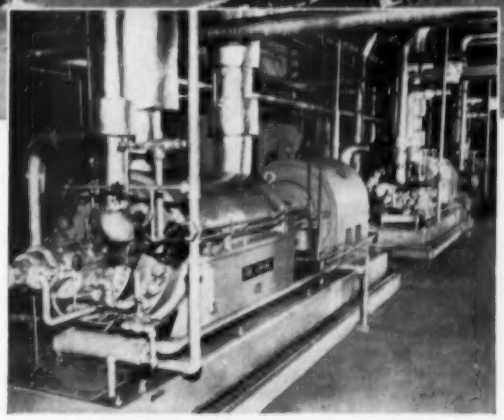
Drawing on a fund of $50,000 appropriated by the two societies to initiate the survey, the new committee's assignment is to design a specific program for financing the survey. Their proposal is expected soon.

Modern central stations use

DE LAVAL

BARREL TYPE BOILER FEED PUMPS





Three ten-stage De Laval high pressure, barrel type boiler feed pumps, are on the line at the Deepwater Station of the Atlantic City Electric Company. Shown above is an aerial view of this station located in Penns Grove, New Jersey at the southern end of the Jersey Turnpike. Each pump delivers 675 gpm to the boiler for a total flow of 685,000 pounds per hour. Each pump operates at 1762 psi with temperature at 287 F., and is driven by a 900 hp motor.

When it came time to modernize one of their existing facilities, Atlantic City Electric Company and Gibbs & Hill, Inc., consulting engineers, chose two similar De Laval pumps to serve a new 79,000 kw generator.

IMO Pumps For Fuel Oil Service

Also doing an important job in this Atlantic City Electric Company station are De Laval IMO screw-type positive displacement pumps. They supply fuel oil to the burners round the clock.

Send for De Laval Bulletin 1506, which contains helpful data.

DE LAVAL *Boiler Feed Pumps*

DE LAVAL STEAM TURBINE COMPANY
816 Nottingham Way, Trenton 2, New Jersey

DL-988

WHAT THEY TELL US

▶**OUR HUNGARIAN CORRESPONDENT,** Loránt Kuti of Budapest, whose request for information on the use of aluminum for condenser tubing was discussed in these columns in the July issue, writes:

> Your letter accompanied by the papers of W. A. Pollock, R. A. Wilson and E. D. Verink came duly to my hand, and I hasten to express to you my very best thanks for your kindness and obliging care you gave to my request. Extra thanks for the data concerning the composition of the aluminum alloy.
>
> Immediately after receipt I thoroughly studied all the literature you sent me and drew from it a lot of knowledge relative to the aluminum condenser tubing.

▶**GETTING IT STRAIGHT.** The following clarification comes from G. Robert Koch of North Bergen, N. J.:

> Having been associated with the planning, design and construction of the St. Lawrence Power Project for nearly three years, I feel qualified to correct certain statements which appeared in the *Engineers' Preview* section of your April issue of POWER ENGINEERING:
>
> (1) You state "all the draft tube liners have been delivered to the site of the Long Sault Power station." Please note that Long Sault was the name of the rapids which were dried up last month by means of a major river diversion scheme. Long Sault will henceforth be the name of the spillway control dam being built just downstream of the site of the former rapids as part of the St. Lawrence Power Project. Since Long Sault Dam will have no power generating facilities, I am sure you meant to say that the draft tube liners are for installation at the Barnhart Island Power Plant, recently also referred to as the St. Lawrence Power Dam.
>
> (2) It is unfortunate that you and many others in the publishing field continue to use the old term "St. Lawrence Seaway" instead of "St. Lawrence Power Project" when referring to the generation of power. These two projects are separate undertakings based on separate authorizations, separate financing, and are being built by separate agencies, namely the St. Lawrence Seaway Development Corporation and the Power Authority of the State of New York, respectively for navigation and power.
>
> (3) The Baldwin-Lima-Hamilton Corp is furnishing eight of the 16 hydraulic turbines to be installed in the American half of the international power house; Allis-Chalmers is supplying the other eight. Each turbine is rated at 71,000 hp, for a total of 1,100,000 installed hp on the U. S. side of the border, duplicated by a similar installation on the Canadian side. Each of the 16 American turbines is matched with a generator rated at 57,000 kw, or 60,000 kva at 95 per cent pf. Sorry, but you slipped when you stated that "the eight generators will produce 120,000 hp."
>
> Please accept the preceding in the spirit of constructive criticism.

Thank you, Mr. Koch.

▶**HUNNICUTT'S A HIT.** We mean, of course, the articles on start-up problems in power plants, by J. H. Hunnicutt, which have been appearing in POWER ENGINEERING. One of the latest letters on this is from John H. Humphrey, superintendent of Carolina Power & Light Co, of Waterville, N. C.:

> I am enjoying the articles on initial operation of the new power plant by J. H. Hunnicutt and was wondering if this series could or would be published in booklet form when completed. I was associated with the operating group of two large power plants and a study of the articles prior to this would have been of great help.

We've received many similar comments and are giving careful consideration to the idea of republishing the series in booklet form. If we do it, we'll give you plenty of warning.

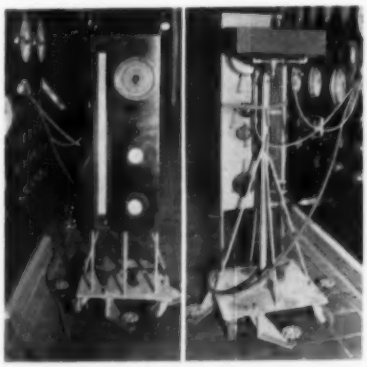
▶**CALLING ALL CONDENSER EXPERTS** — on behalf of W. Cronin of the Bord Solathair An Leictreachais (Electricity Supply Board) of Dublin, Ireland. Mr. Cronin has written us:

> We are at present investigating the latest developments in the mechanical design of turbine condensers for outputs from 20 to 60 mw. We should be much obliged if you could let us have some references and data on the following:
>
> (a) Condenser design — arrangement of the tube supports, baffles and material used, and dimensions based on an economic study.
>
> (b) The general specification of condenser tubes, and heat treatment when the tubes are expanded at both ends as compared with tubes that are packed; and methods used to allow for expansion of the tubes, when fixed at both ends. Also, the thickness generally used for tube walls.
>
> (c) The trends in the design of auxiliary equipment and whether the tendency is to use steam jet ejectors or water ejectors and the number of condensate pumps usually installed.

We're assembling an answer to Mr. Cronin and would like to include data and references contributed by readers of this department. Please send us your ideas for this Irish question.

▶**WE DO IT, TOO,** writes Joseph A. Fischer in regard to our article (April issue) on the calibration and testing of meters as done at the St. Clair Station of Detroit Edison. Fischer is performance supervisor at the Burlington Station of the Public Service Electric and Gas Co of New Jersey. He tells us:

> We have a similar device for the calibration of differential meters and I thought your readers might be interested in seeing photos of our setup.
>
> The only difference between the setup mentioned in the article and our test setup is the use of an open head on the flow meter. We believe that this permits a more positive zero differential check by being certain that the bell is resting on the standpipe; secondly, that the water legs on both sides of the meter are always identical by adjustment of head tank to overflow point located on the open head device. Finally, it permits internal adjustments during calibration.
>
> Advantages in using the test stand are identical with those mentioned in the article. However, I would like to mention that we have cut our meter calibration manpower time by about 50 per cent since putting the test stand in service in 1955. Material and equipment for the test stand cost approximately $500.



Front and rear view of flow meter test rack used by Burlington, N. J., Station

How Steam Trap Standardization *reduces Installation and Maintenance Work and Cost*

No Bypasses Needed. Traps can be replaced in a couple of minutes by uncoupling the unions and installing a "spare" trap complete with proper length pipe connections and half unions.

ORIFICE SIZES	
PRESSURE	SIZE
0-40	7/64
40-60	3/32
60-150	1/8

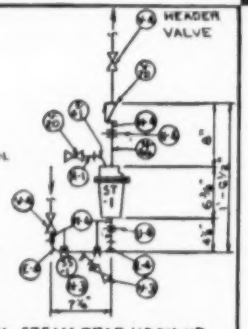
CAPACITY-0-300#/HR

NOTES:

DIMENSIONS SHOWN ARE FOR MINIMUM SPACE INSTALLATION

IN LONG RUNS - PIPE TO BE PITCHED TOWARD TRAP.

TRAP TO BE INSTALLED BELOW DRAIN POINT IF POSSIBLE. IF NOT POSSIBLE, A CHECK VALVE MUST BE INSTALLED ON INLET SIDE OF TRAP.



BILL OF MATERIAL FOR TYPICAL STEAM TRAP HOOK-UP

MARK	REQD	MAT'L	DESCRIPTION
ST-1	1	ELEC. ARC WELD STEEL	1/2" STEAM TRAP - ARMSTRONG #211
SS-1	1	STEEL	1/2" STRAINER - 250# W.S.P. - [redacted]
V-4	2	BRZ	1/2" GATE VALVE - SCRD - 200# W.S.P. - [redacted]
V-20	1	BRZ	1/2" GLOBE VALVE - SCRD - 200# W.S.P. - [redacted]
V-3	1	BRZ	1/2" GATE VALVE - SCRD - 200# W.S.P. - [redacted]
V-70	1	BRZ	1/2" CHECK VALVE - SCRD - 200# W.S.P. - [redacted]
E-4	2	FORGED STEEL	1/2" - 90° SCRD ELL - 2000#
E-41	1	FORGED STEEL	1/2" - 90° STREET ELL - 3000# - [redacted]
U-4	2	MALL. IRON	1/2" UNION - 2000# - [redacted]
N-1	1	STL	1/2" SHORT NIPPLE - SCH. 80 - SEAMLESS ASTM A-53
N-3	1	STL	1/2" SHORT NIPPLE - SCH. 80 - SEAMLESS ASTM A-53
N-4	6	STL	1/2" SHORT NIPPLE - SCH. 80 - SEAMLESS ASTM A-53
N-4/4	1	STL	1/2" - 4" LG. NIPPLE - SCH. 80 - SEAMLESS ASTM A-53

Standardized hookup includes test valve for trap testing, strainer, blowdown valve for cleaning trap, shut-off valves and unions for quick replacement.

Trap Maintenance Costs Reduced $25,000 per Year with Armstrongs

Major reductions in steam trap installation and maintenance work and cost can be achieved by standardization on one make of trap which, in turn, permits standardized hookups. A major chemical company reports an annual maintenance saving of $25,000 since installing 4000 Armstrong traps according to the drawing and photograph shown here. Additionally, trap parts inventory is reduced and purchasing is simplified.

Traps of a Size Interchangeable. Note that exact dimensions are given for the pipe fittings, including nipples connected to each size of trap. When a trap needs repair, the unions can be uncoupled, the trap lifted from the line, and a "spare" carrying identical pipe connections slipped in place. In as little as one or two minutes, a faulty trap is replaced. It is then repaired and takes its place as a "spare".

$25,000 Trap Maintenance Saving. Records on the Armstrong trap installation described here show that the cost of repair parts was approximately $10,000 less annually than with the traps previously used. Reduction in maintenance labor brings the total saving to $25,000, per year. *And, fuel savings attributable to the traps are at least equal to the maintenance saving.*

FOR COMPLETE INFORMATION on the traps that slash maintenance costs ask for the Armstrong Steam Trap Book containing complete data plus selection, installation and maintenance recommendations. Call your local Armstrong Representative or write.

ARMSTRONG MACHINE WORKS, 8108 Maple Street • Three Rivers, Michigan

ARMSTRONG STEAM TRAPS

For more data circle 505 on Post Card

now fully

YARWAY REMOTE BOILER

With the addition of the new pressure compensator described on opposite page, full-scale accuracy of water level indication is provided not only at "working pressure" but *also at all other boiler pressures.*

The Yarway Remote Indicator now offers *completely accurate readings of the boiler water level under every operating condition.*

For complete information on Yarway Indicators and pressure-temperature compensation, write for Bulletin WG-1814 and new compensator supplement.

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

NOTE: Ask about the application of Yarway Indicators for 900 psi and higher pressures under Boiler Code Case 1155 (two indicators in place of one of the two required gage glasses).

YARWAY

...a good way

compensated
WATER LEVEL INDICATORS

ADVANTAGES OF YARWAY PRESSURE COMPENSATOR

1. Compensating mechanism is applied to the Yarway indicator without change in internal construction of the indicator.

2. Well-known dependability of bourdon tube insures reliability and long life.

3. Trouble-free operation because linkage is simple and direct.

4. For maximum sensitivity, the indicator pointer is mounted on jewel bearings.

5. Rugged shock-resistant mounting carries weight of compensator mechanism without burdening the pointer mechanism.

6. Boiler conditions are readily simulated for check of instrument calibration at operating pressures, with remainder of indicator system under atmospheric pressure.

7. Application of pressure-temperature compensation for density changes in boiler water insures desired accuracy of level indication at all operating pressures and at all points on the pointer scale.

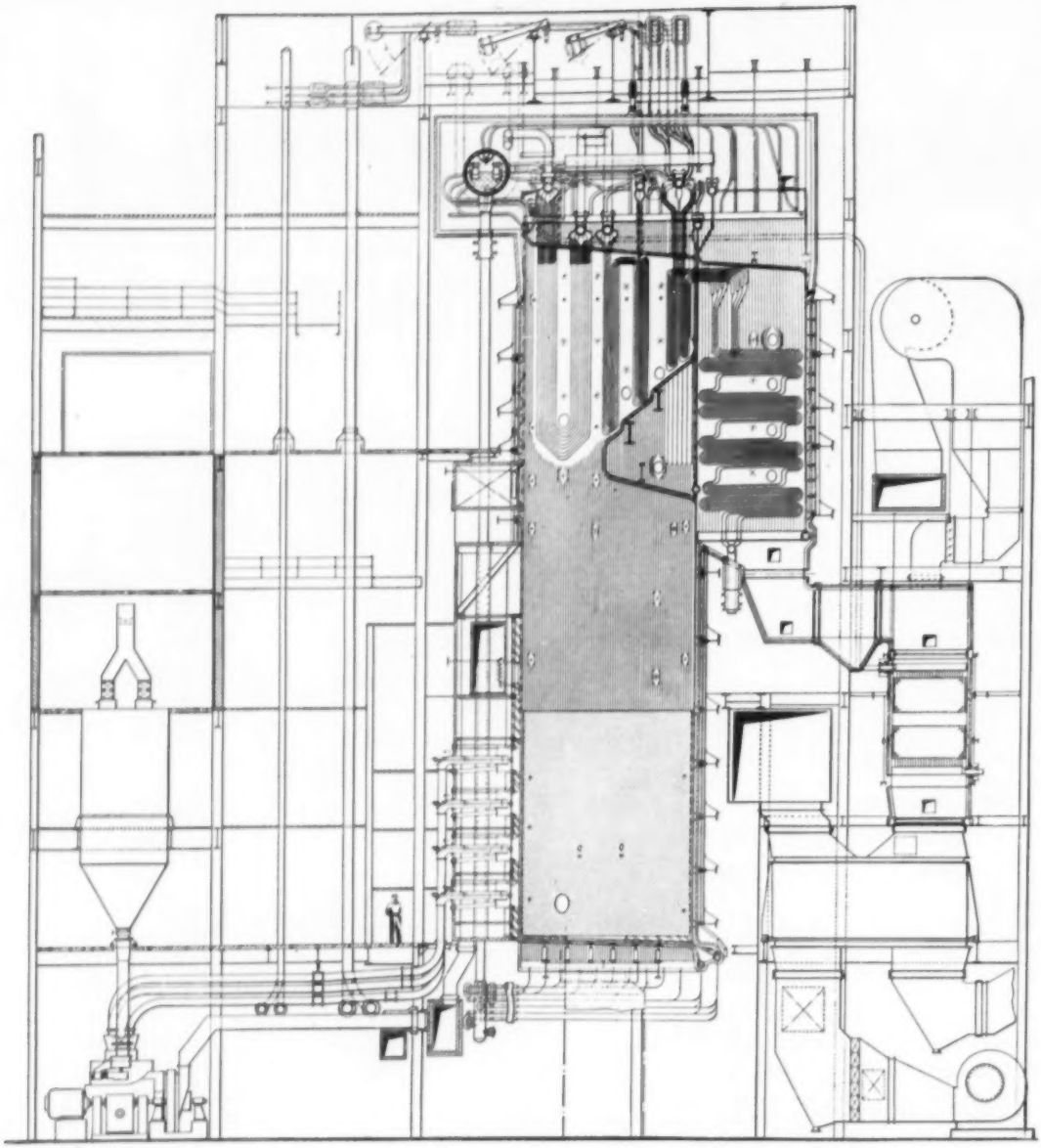
Model showing mechanism of Yarway Pressure Compensator. Placed between indicator operating and indicating elements, the compensator mechanism corrects the level indication by changing pointer travel to compensate for variation in water density due to changes in boiler pressure.

(Not shown) Yarway Remote Hi-Lo Alarm Signals (lights and/or horns), operated by the Indicator. May be placed at any location in the plant.

(Not shown) Yarway Electronic Secondary Indicator to provide duplicate reading at any other location. Same size and appearance as primary indicator.

to specify remote liquid level indicators

For more data circle 506 on Post Card



Latest unit for Burlington Station, Public Service Electric & Gas Company has a capacity of 1,350,000 lb of steam per hr. Comprehensive circulation tests on this unit, plus more than a year of sustained performance, proved that natural circulation boilers can operate easily with drum design pressures of 2800 psi, for throttle conditions over 2400 psi.

B&W NATURAL CIRCULATION BOILERS ABOVE 2600 PSI DESIGN PRESSURE

NAME OF UTILITY	STATION	NO. UNITS	DES. PRESS. psi	THROTTLE PRESS. psi	TOTAL TEMP. F	REHEAT TEMP. F	TOTAL KW
Indiana & Michigan Electric Co.	Twin Branch	1	2650	2335	940	900	76,500
Public Service Electric & Gas Co.	Burlington	1	2700	2350	1100	1050	200,000
Public Service Electric & Gas Co.	Linden	1	2700	2350	1100	1050	225,000
Southern California Edison Co.	Huntington Beach	2	2700	2400	1050	1000	400,000
Virginia Electric & Power Co.	Bremo	1	2700	2400	1000	1000	150,000
International General Electric Company	Chiba	1	2700	2400	1060	1010	175,000
Memphis Light, Gas & Water Div.	Thos. H. Allen	3	2825	2400	1053	1053	862,500
Detroit Edison Co.	St. Clair	1	2700	2400	1050	1000	325,000
Virginia Electric & Power Co.	Portsmouth	1	2700	2400	1000	1000	150,000
Southern California Edison Co.	Mandalay	2	2700	2400	1050	1000	400,000
Pacific Gas & Electric Co.	Pittsburg	2	2725	2400	1050	1000	660,000
TOTAL CAPACITY SERVED							3,624,000

If You Are Considering...

2400 PSI THROTTLE CONDITIONS

You'll Want to Investigate B&W's Unique Experience

There's a reason why so many progressive utility companies and their engineers, thinking of turbine throttle conditions of 2400 psi, have turned to B&W. It is the unique record of performance of B&W high pressure natural circulation boilers.

Simplicity of installation and operation has been brought to high pressure steam generation by B&W natural circulation boilers. They have lower operating costs because no machinery requiring power and maintenance is needed for circulation.

Long range operating experience—since 1939—has been gained with natural circulation high pressure boilers operating above 2000 psi. Operators' success with natural circulation boilers is due to the B&W Cyclone Steam Separator, and a design which makes liberal use of outside downcomer capacity and provides proper balance of makeup and riser tubes.

Clean turbines are an extra plus value. Cyclone Steam Separators not only maintain good circulation, but, used with Steam Washers, they maintain exceptionally clean turbines. At one plant, where a B&W Radiant Boiler has been on the line constantly for a year, the turbine manufacturer reports that the turbine is the cleanest high pressure unit his engineers have ever seen. And tubes in the high duty part of the furnace are as clean internally as the day they were installed.

B&W first designed natural circulation boilers for operation at drum pressures over 2000 psi nearly 20 years ago. Today 86 B&W natural circulation boilers with these high design pressures are in operation and 52 more are being built.

The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

G-845-C8

BABCOCK & WILCOX

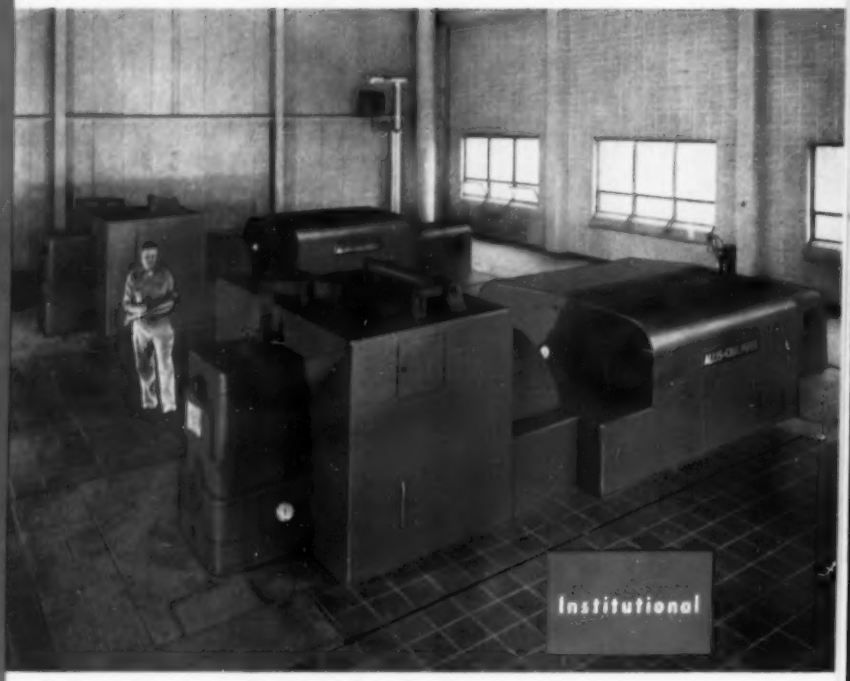
BOILER DIVISION

For more data circle 507 on Post Card

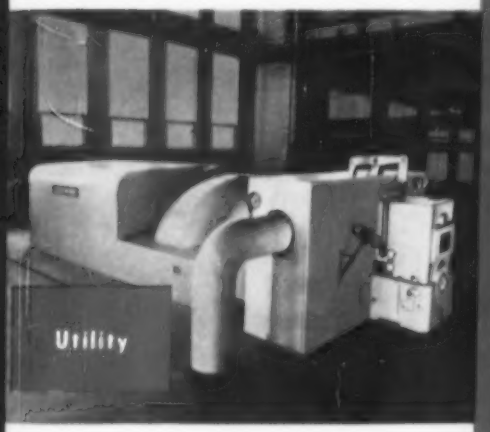
ALLIS-CHALMERS STEAM

The Choice of

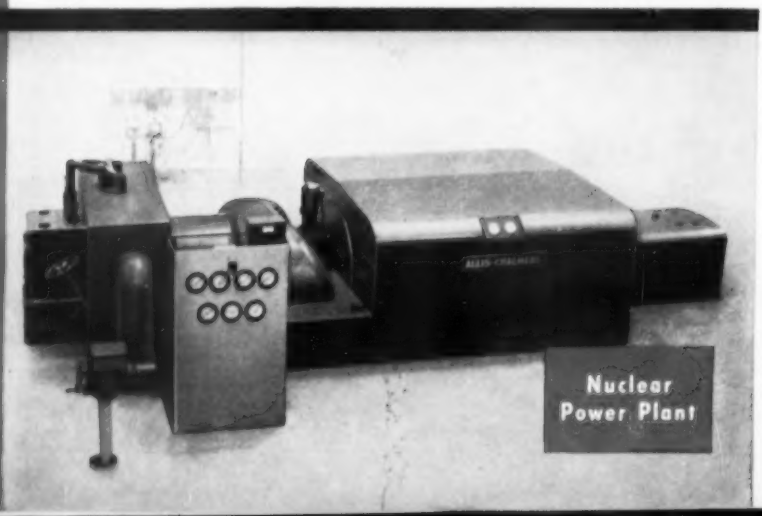
ONE OF THREE Allis-Chalmers steam turbine generator units in a large brewery. This 5000-kw condensing, automatic extraction, impulse unit generates electricity as a by-product of process steam.



LARGE QUANTITIES of steam are required for heating, laundry, and other services. These 3000-kw Allis-Chalmers non-condensing, automatic extraction turbine-generator units supply steam at two pressures as well as electric power.



A MINNESOTA CITY supplies business district and residential heating steam, and electric power with this recently installed 7500-kw condensing, automatic extraction steam turbine generator unit.



THIS 5000-kw condensing steam turbine generator unit was designed to meet the special requirements of a nuclear power plant. In addition, Allis-Chalmers supplied the switchgear, condenser, pumps, motors and other auxiliaries.

TURBINE GENERATOR UNITS

Modern Power Plants

Condensing . . . non-condensing and automatic extraction units are available for wide range of services

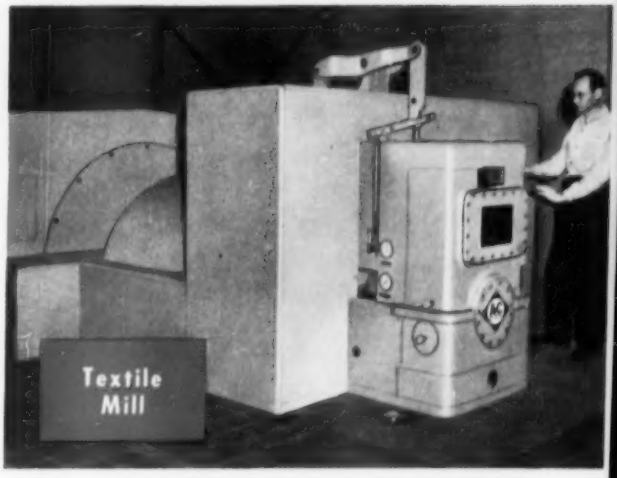
UTILITIES, breweries, textile mills, medical institutions, and a nuclear power plant enjoy the low installation and operating costs of Allis-Chalmers WA-Series steam turbine generator units.

These modern, compact units complement the most modern plant design. They are built in NEMA ratings through 10,000 kw . . . AIEE-ASME preferred ratings to and including 16,500 kw.

Users of these Allis-Chalmers turbines enjoy an important advantage. "Big turbine" features are incorporated in their design.

For example, the centrifugal-type speed governor is the same type used in large Allis-Chalmers steam turbines. Steam seals are the same labyrinth type used in turbines up to 300,000 kw. Removable external glands, high chrome alloy steel buckets and nozzles are other features. The 16,500-kw units with hydrogen-cooled generators have the same type of hydrogen seals as used on the large sizes.

Unit shipment with rotors individually locked in place cuts installation time and cost. Foundation cost is reduced because oil piping and generator air coolers are above the floor line.



PROCESS STEAM in a synthetic yarn plant produces electric power as a by-product with this 5000-kw non-condensing steam turbine generator unit.

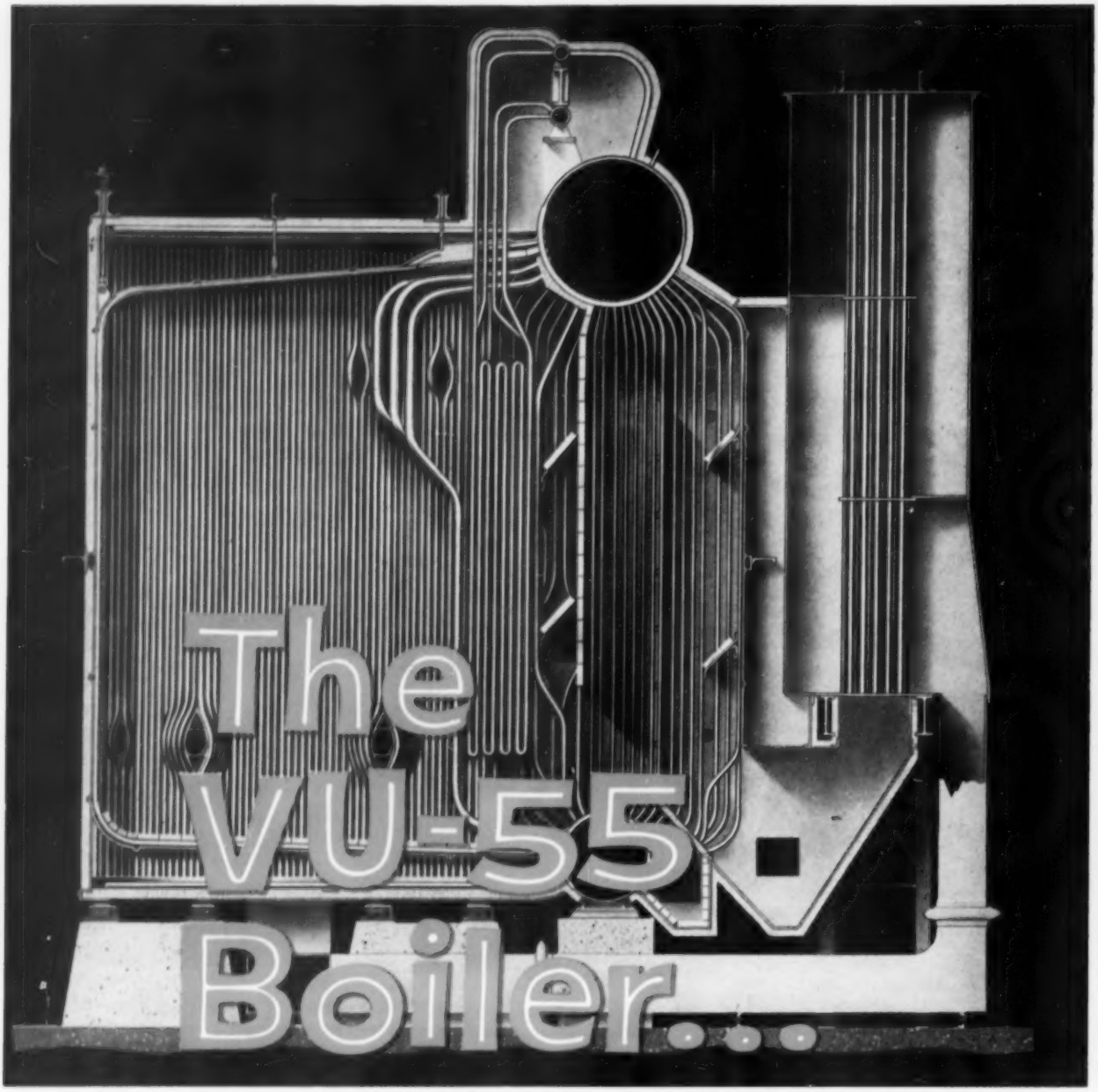
GET MORE FACTS on these economical units. Call your nearby A-C office or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

A-C ALLIS-CHALMERS

A-5437

ALLIS-CHALMERS

For more data circle 508 on Post Card

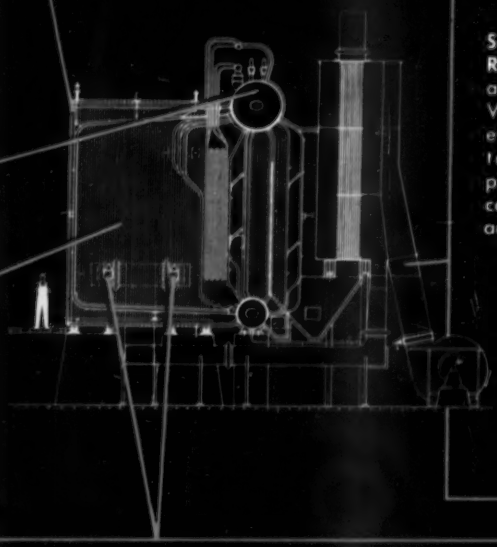


Custom Features, Standard Sizes, Advanced Design

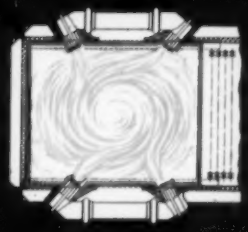
DOUBLE WALL, PRESSURE-TIGHT CASING. The latest development in casing construction for pressure firing of boilers in the size class of the VU-55, this casing is designed to assure life-time tightness with minimum heat loss. Pressure firing permits the elimination of an induced draft fan with its attendant operating and maintenance costs. Construction consists of tangent tubes backed up successively by welded steel panels, 4 inches of high quality insulating material and an outer steel casing formed as shown to provide adequately for expansion and assure ample strength. Low heat loss and the tightness required for pressure firing are assured by this double-wall construction.

HIGH STEAM QUALITY. Equipped with a large (60-in.) steam drum, the VU-55 has generous water capacity and steam reservoir space. C-E drum internals assure high quality steam at all ratings.

TANGENT FURNACE TUBES. The VU-55's furnace tube arrangement provides complete heat-absorbing, water-cooled protection on all furnace walls. Furnace maintenance is minimized, refractory expense is eliminated, heat absorption rates per sq. ft. are higher.



STREAMLINED EXTERIOR. The over-all appearance of the VU-55 reflects the efforts of its designers to achieve a completely unobstructed casing, while retaining adequate access wherever required and every facility for convenient operation. There are no outside downcomer tubes, and the ducts from air heater to burners are beneath the furnace floor.



TANGENTIAL FIRING. More than 20 years of application experience have established the exceptional advantages of tangential firing. About 90 percent of Combustion's large utility installations use this advanced method of firing. Flame streams from the four burners impinge upon one another at high velocity, as shown, creating a turbulence unattainable by any other method of firing. The result is rapid and complete combustion. As the gases spiral upward, they sweep all furnace heating surfaces, assuring a high rate of heat absorption.

The VU-55, newest of the C-E line of Vertical Unit Boilers, represents the closest approach to central station performance yet achieved in standardized boilers in its capacity range.

Its design combines a number of time-tested and service-proved features, such as Tangential Burners, double wall, pressure-tight casing, and tangent furnace tubes. In addition, this bottom-supported unit requires no outside supporting steel, is economical of space and streamlined in appearance.

It is available in 5 sizes for capacities from 50,000 to 120,000 lb per hour. It is designed for 3 pressure ranges (250, 500 and 750 psi) and can be equipped with a superheater to provide temperatures up to 750 F. Either a tubular or a regenerative air heater is available.

The VU-55 Boiler is symmetrical in design, performs efficiently over a wide range of output, and is easy to operate and maintain.

It is, in fact, the boiler with the custom features and the advanced design.

COMBUSTION ENGINEERING

B-978

Combustion Engineering Building

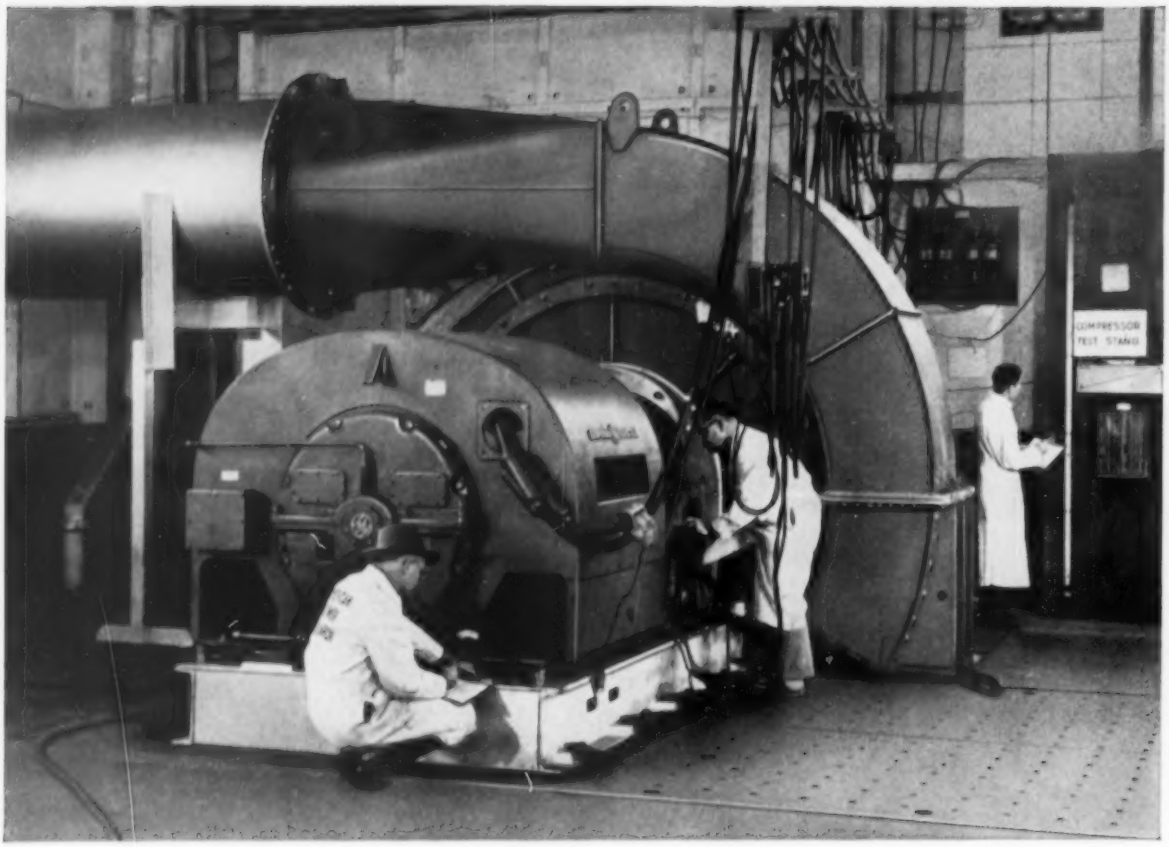
200 Madison Avenue, New York 16, N. Y.

Canada: Combustion Engineering-Superheater Ltd.

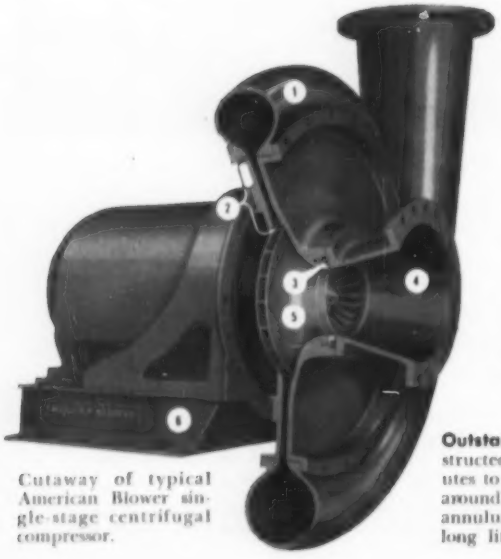
all types of steam generating, fuel burning and related equipment; nuclear reactors; paper mill equipment; pulverizers; flash drying systems; pressure vessels; soil pipe.

For more data circle 509 on Post Card

Here's the latest air-handling



LABORATORY TESTED CENTRIFUGAL COMPRESSOR DELIVERS 330,805 POUNDS OF AIR PER HOUR!



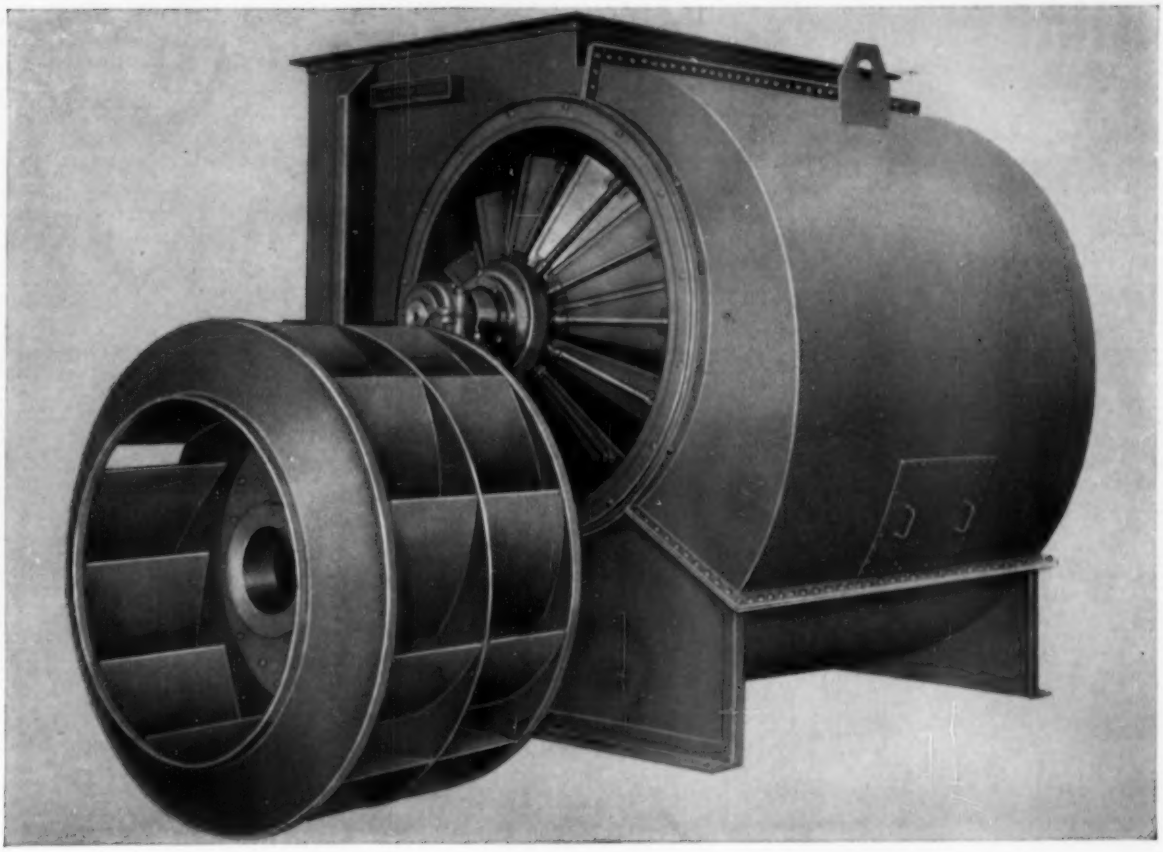
Cutaway of typical American Blower single-stage centrifugal compressor.

With the trend toward higher pressure requirements, American Blower has designed and built centrifugal compressors to furnish air for cyclone fired boilers. These compressors incorporate the use of a horizontally split, welded steel volute casing, variable inlet guide vanes, welded steel impeller of the shrouded type with impeller shaft supported by two journal bearings plus a Kingsbury thrust bearing arranged for positive forced-feed lubrication. This highly efficient compressor is driven by a 1000 HP, 1800 rpm, induction motor, delivers 330,805 pounds of air per hour at a static discharge pressure of 67.5 inches water gauge.

Like every American Blower single-stage centrifugal compressor – 30 to 2250 HP – this compressor has been completely tested in accordance with the A.S.M.E. Power Test Code. Such testing guarantees the mechanical operation and performance of all American Blower compressors.

Outstanding features: (1) Improved scroll-shaped casing design. (2) Unobstructed long diffuser passage converts velocity energy into pressure, contributes to quiet operation. (3) Annulus packing minimizes recirculation of gas around impeller inlet. (4) Removable inlet nozzle for accurate alignment of annulus packing. (5) Aero-dynamic design of impeller blades for high efficiency, long life. (6) Welded-steel baseplate "stress relieved" prior to machining.

equipment from American Blower

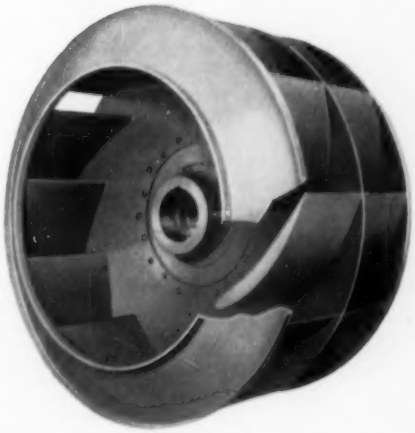


AIRFOIL FAN HAS ADVANCED DESIGN FOR HIGH EFFICIENCY, LOW OPERATING COST

Featuring a functionally designed airfoil blade, American Blower's improved Airfoil Fan is the industry's best in the non-overloading-horsepower type of centrifugal fan.

That's because smooth interworking of improved streamline inlets, wheel rims, and housing minimizes turbulence, resulting in higher efficiency, lower power consumption. The non-overloading-horsepower characteristic makes it possible to select a driving motor close to the fan horsepower.

Why not talk to an American Blower sales engineer about *your* requirements. His knowledge of air-handling applications can prove invaluable to you. Call our nearest branch office, or write: American Blower Division of American-Standard, Detroit 32, Michigan. In Canada: Canadian Sirocco products.



Special design of the airfoil blade and matching streamline inlet are the top features of American Blower Airfoil Fan. The dieformed, reinforced, and welded blades are extra strong, extremely efficient. Single- and double-inlet Airfoil Fans are available in many sizes, and for volumes up to 1,000,000 cfm.

AMERICAN BLOWER

Division of AMERICAN-Standard

For more data circle 510 on Post Card

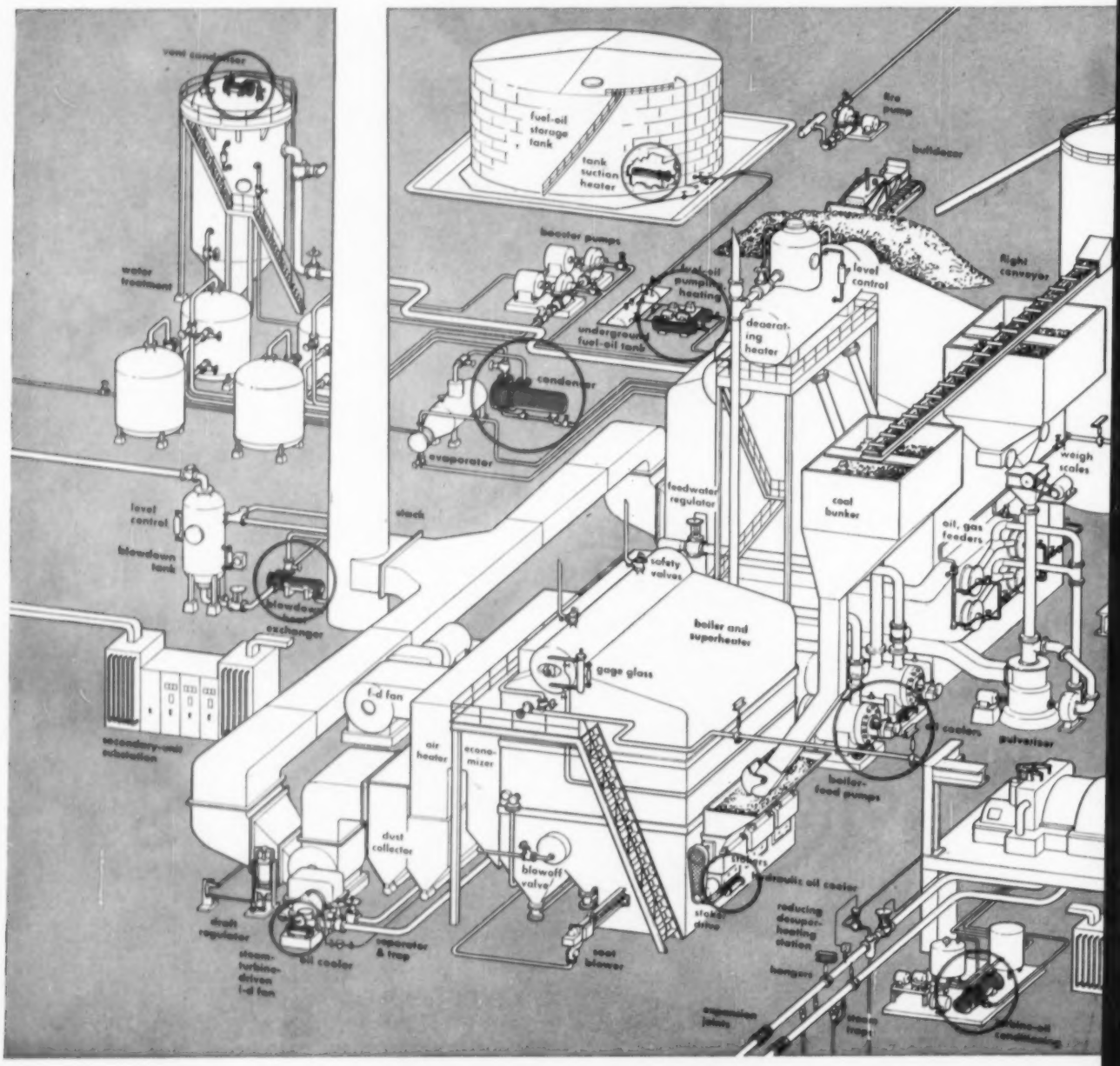
ROSS

Ross Exchangers and Condensers perform

This layout of a modern steam power plant could be yours today or a blue print of your future one. It could be a central station or an industrial plant. The interrelated equipment could represent all of your needs, part of your needs or more than you need.

From the standpoint of heat exchange and condensing equipment, however, this one fact stands out firmly: Regardless of the function and the condition, there's a Ross Exchanger and Condenser to meet *every* power plant requirement. See for yourself. Surface Condenser? It's there. Feedwater Heater? It's there. Blowdown Exchanger? It's there. Fuel Oil Heater? It's there. Now look over the machines and other equipment that require oil cooling — the Diesels, air compressors, turbines, transformers, boiler feed pumps. There's a Ross Exchanger to serve every one of them. The compressor cylinder-mounted intercoolers, the hydraulic oil coolers for the stoker drive, the jacket water coolers for both engines and compressors, the tank suction heaters . . . on it goes from one end of the plant to the other.

Where does the list end? It doesn't with Ross.



numerous services in the modern steam power plant

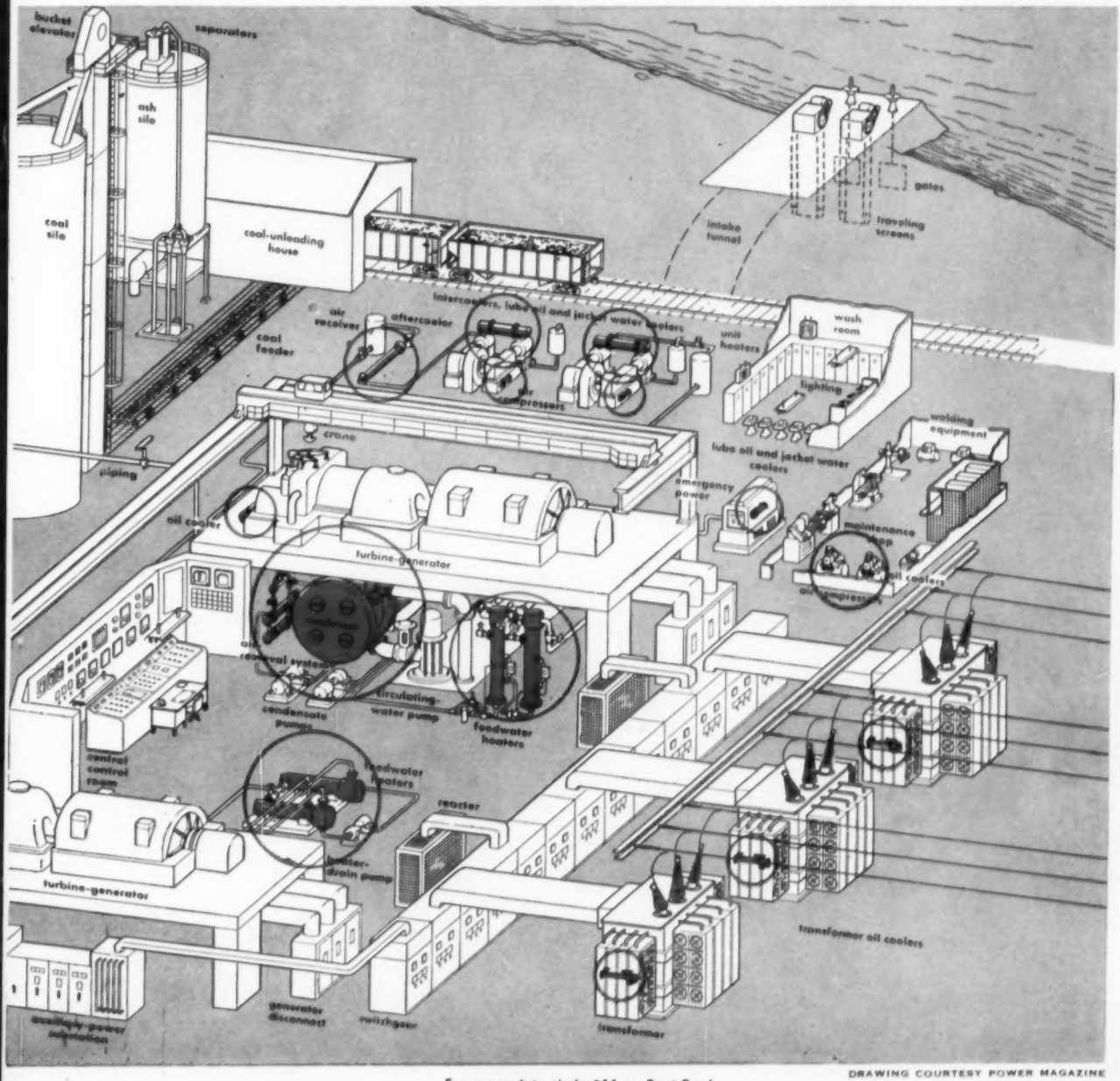
Standard or special, primary equipment or machine components, large or small, one of a kind or dozens alike, Ross Exchangers and Condensers are designed and built for optimum performance in every type of service within the modern steam power plant.

And of this you can be sure: A Ross engineer, in consultation with yours, not only has the most to offer in the way of equipment, but the most in experience, too. The name Ross is renowned in the power generation field — utilities, industries, institutions, major buildings, engineering and contracting firms throughout the world.

Complete literature on specific products will be mailed promptly at your request. Write: Ross Heat Exchanger Division of American-Standard, Buffalo 5, N. Y. In Canada: American-Standard Products (Canada) Limited, Toronto 5, Ont.

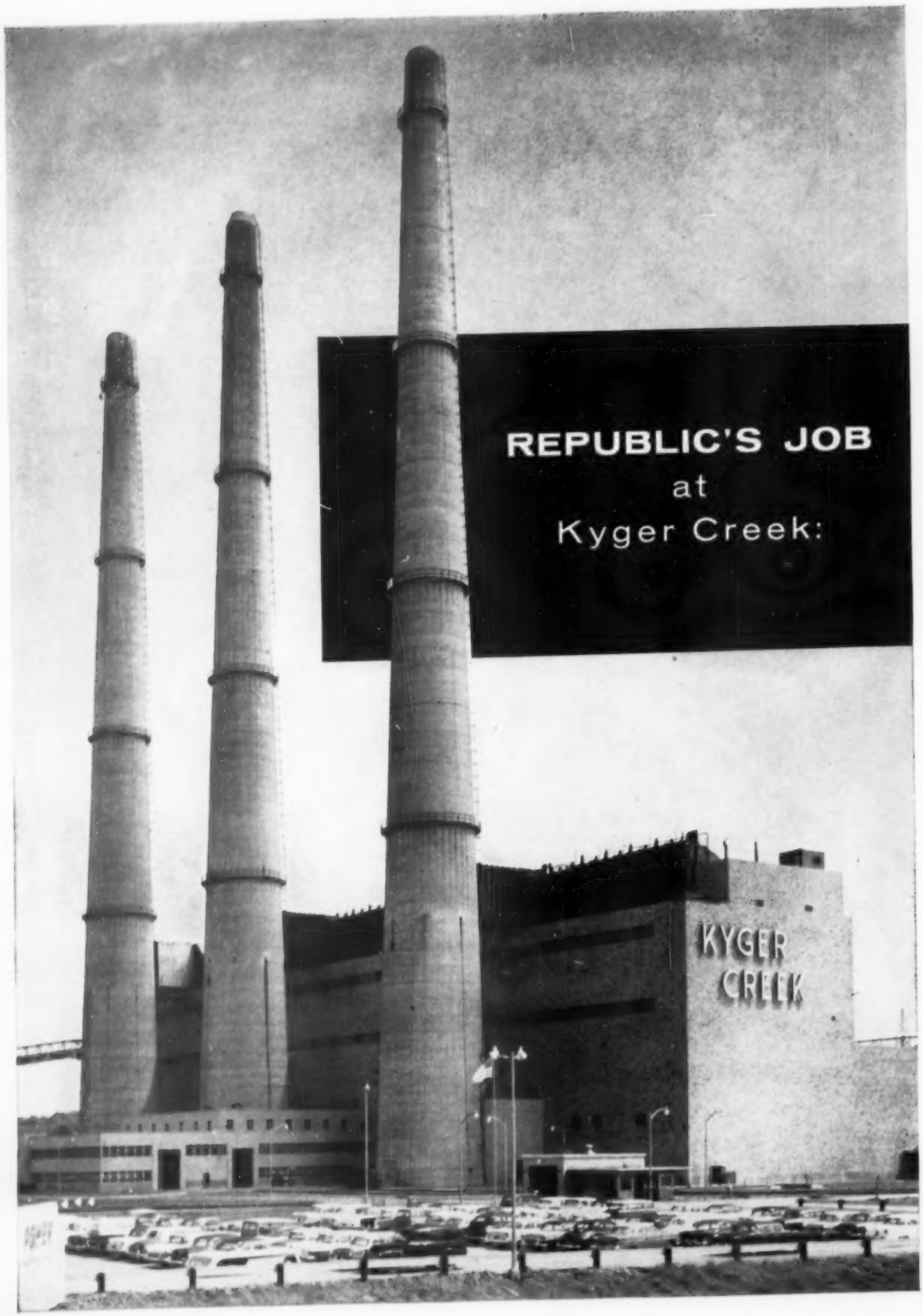
ROSS HEAT EXCHANGER

Division of **AMERICAN-Standard**



DRAWING COURTESY POWER MAGAZINE

For more data circle 511 on Post Card


REPUBLIC'S JOB
at
Kyger Creek:
KYGER
CREEK

One of the five control centers where an "Electronic Master" automatically integrates data and master-loads pneumatic power operators throughout the unit. Manual operation of any function can be taken over by the man on duty at a moment's notice.

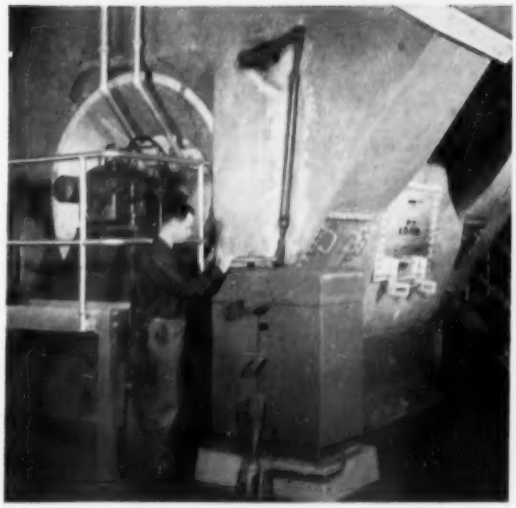
Primary air and coal to each pulverizer (7 per boiler) is pneumatically adjusted to each load by the "Electronic Master," which always holds the desired fuel/air ratio. Electronic loadings can be remotely adjusted to regulate the portion of total fuel fired by each pulverizer. An electronic fuel splitter and fuel totalizer automatically divide the coal in the desired ratios among all pulverizers in operation, permitting the addition or removal of pulverizers from the line with minimum disturbances.

control five 1,400,000 lb./hr. boilers —automatically

Kyger Creek Power Plant of the Ohio Valley Electric Corp. produces a million kilowatts for our national atomic program — which makes it one of the most critical power plants in the world.

To keep each of the five huge boilers at top efficiency at all loads, it is necessary to regulate 7 coal pulverizers, 14 burners, 2 F.D. fans, 2 I.D. fans, and many shut-off and regulating dampers as if they were a single unit. The Republic *load* sensing combustion control with the "Electronic Master" keeps tabs on all these inter-related functions. This system makes sure that every change in steam flow is countered with the corrected fuel, air and draft settings *before the load change produces a change in steam pressure.* A follow-up *pressure* control system makes final corrections in control signals (if needed) to hold pressure fluctuations near zero.

Kyger Creek Plant is unusually efficient (7 lb. steam per kwhr) and is one of the country's largest steam plants, but the Kyger Creek combustion control problems are the same ones encountered in any plant striving for stability and peak efficiency. Republic's experience with plants of all sizes, all pressure and temperature ranges, and all load characteristics is your best guarantee of getting all the premium performance built into your major equipment. Never assume any proposal is *best* until you have checked with Republic engineers; they can save you operating, performance and maintenance problems for the full life of your plant.



To permit furnace pressure regulation without upsetting combustion air supply, I.D. fans (above) are interlocked with the F.D. fans through the furnace pressure and air flow regulators. I.D. fans are needed only 5% of the time. All fans are constant speed with inlet vane controls, and can be isolated by means of remotely-operated shutoff dampers.

REPUBLIC FLOW METERS CO.

A Subsidiary of Rockwell Manufacturing Company

2240 Diversey Parkway • Chicago 47, Illinois

For more data circle 512 on Post Card

1 Package 1 Shipment

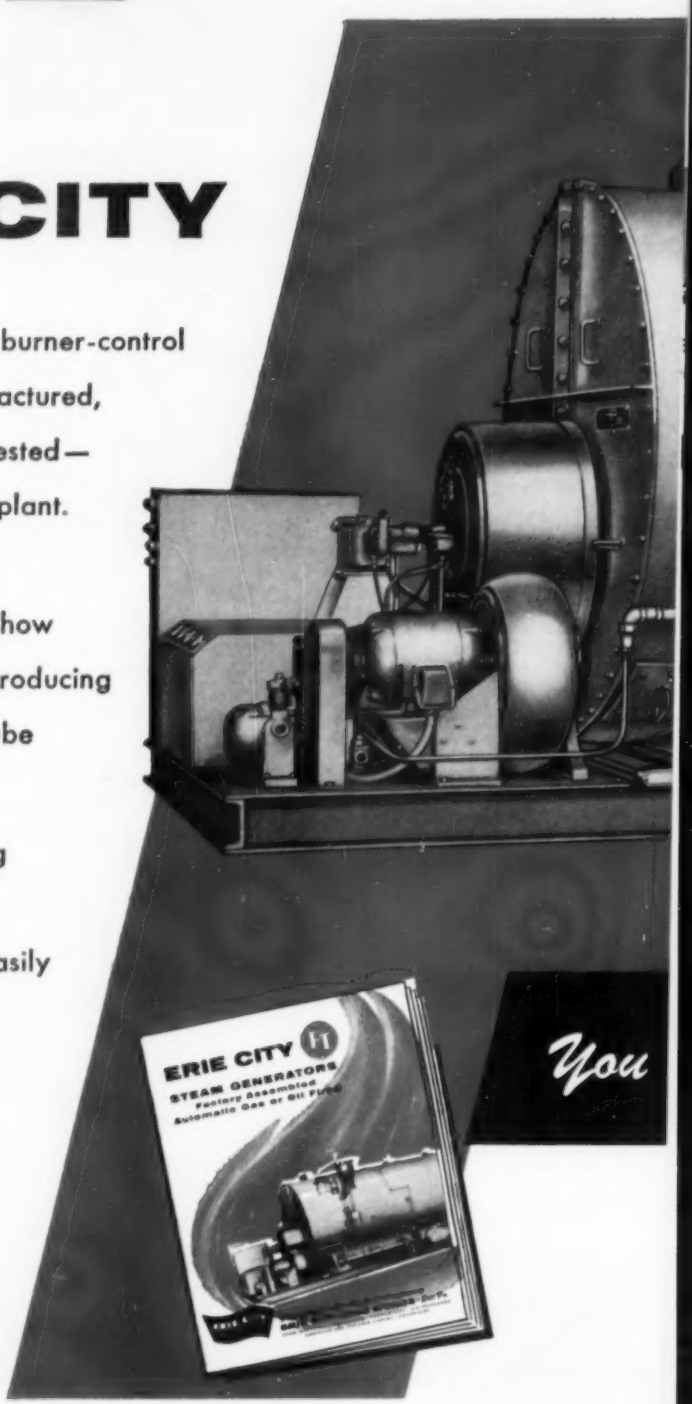
That's FT by ERIE CITY

● A truly modern conception of the boiler-burner-control package fire tube steam generator. Manufactured, assembled, wired, piped, and factory fire tested—ready to go to work when it reaches your plant.

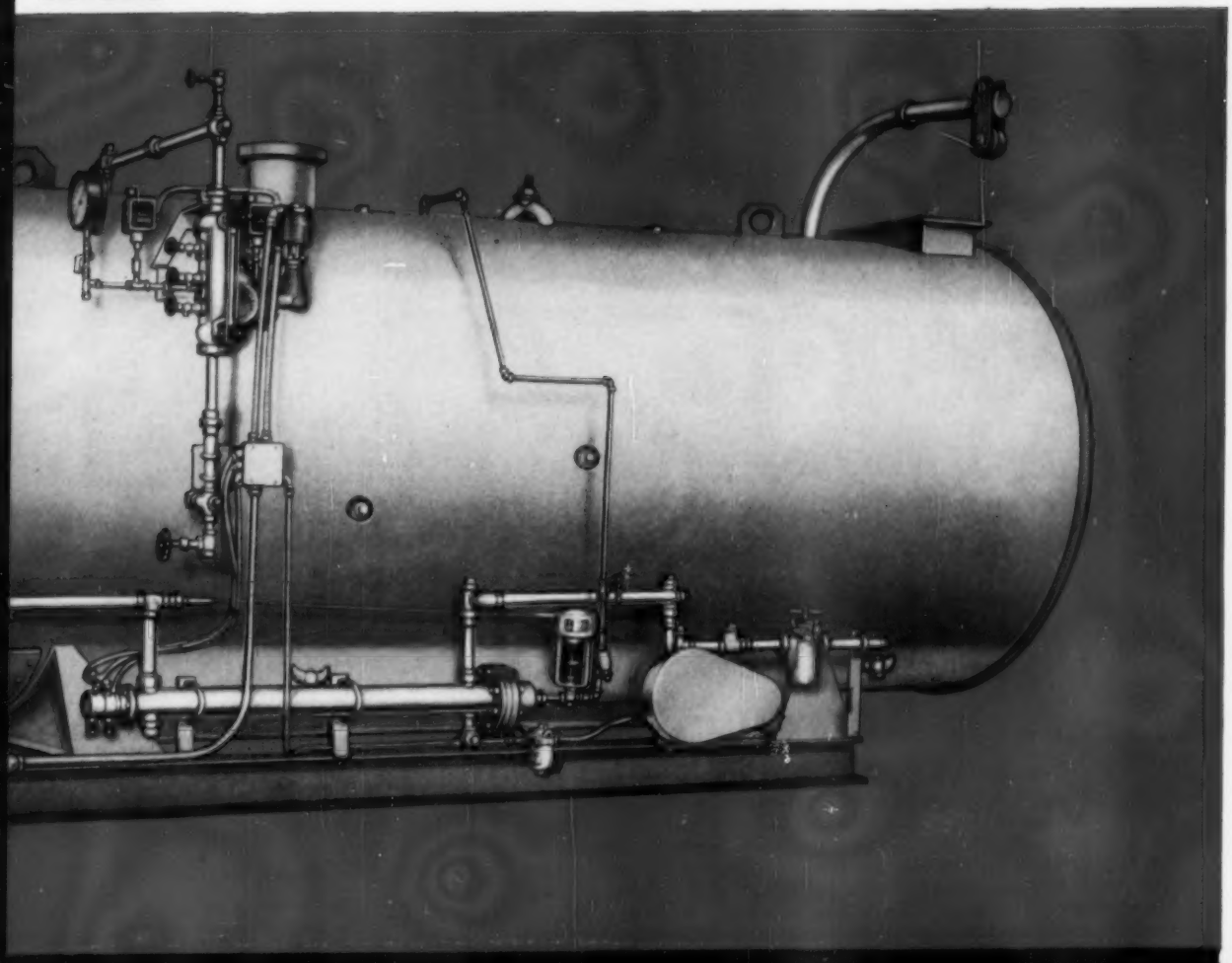
Behind this Erie City package unit is the manufacturing skill and engineering know-how acquired through more than a century of producing large, high pressure, water tube and fire tube industrial power boilers.

The FT is conservatively designed, having five full square feet of heating surface per developed horsepower. Peak ratings are easily attainable with no undue strain on the boiler and its attendant high maintenance costs.

For a complete description of the FT write for Bulletin, SB-563H.



1 Responsibility



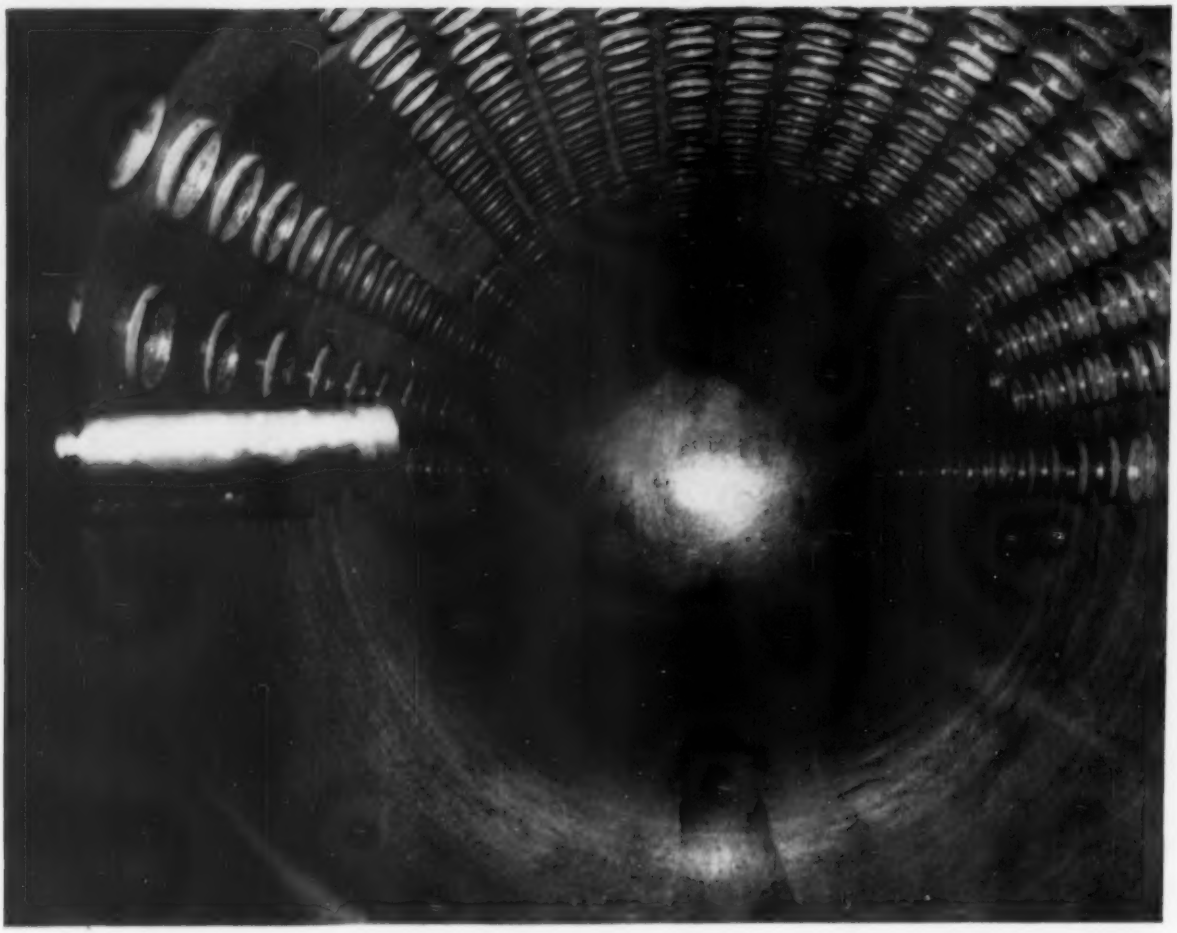
can depend on Erie City for sound engineering . . .

ERIE CITY
117 Years in Steam Generation

ERIE CITY IRON WORKS • *Erie, Pa.*

STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS
UNDERFEED AND SPREADER STOKERS • PULVERIZERS

For more data circle 513 on Post Card



No Sludge . . . No Scale . . . No Corrosion in this boiler

Opened for inspection, this large boiler drum shows the results of a year's attention to good water treatment: *nothing!* No sludge, no scale, no corrosion . . . Ready to go back on line without even a wash-out . . . Down time and maintenance minimum, fuel economy and operating efficiency tops . . . Thanks to The Nalco System of Water Treatment, and good plant control practices.

Nalco System treatment includes proper water treating chemicals *plus continuing Nalco service* that assures effective protection for your steam and water system—from raw water intake through condensate return lines.

For prompt action and straightforward assistance on any water treatment problem, call on Nalco.

NATIONAL ALUMINATE CORPORATION
6224 West 66th Place • Chicago 38, Illinois

CANADA: Alchem Limited, Burlington, Ontario
NORTHWESTERN UNITED STATES, HAWAII and ALASKA
The Flox Company, Inc., Minneapolis 3, Minnesota
ITALY: Nalco Italiana, S. p. A. SPAIN: Nalco Espanola, S. A.
WEST GERMANY: Deutsche Nalco-Chemie GmbH

LOOK TO NALCO FOR
GOOD WATER TREATMENT

and for:

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THE *Nalco*® SYSTEM . . . SERVING INDUSTRY THROUGH PRACTICAL APPLIED SCIENCE

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HELPFUL BULLETINS

INSTRUMENTS AND CONTROLS

101 Supervisory Control — Centralized, economical control of widespread, remote operations, as accomplished by the Synchro-Scan supervisory control system, is described in 12-pp Bulletin 240-P2A. This system controls operation of any combination of pumps, valves, circuit breakers and other devices, and it utilizes "plug-in" components. Bulletin is generously illustrated, and designed to show how this system is developed from a simple to more complex form. Includes data on means of signal transmission, standard accessories. Builders-Providence, Inc.

102 Dynamic Process Control — Bulletin G-102, 24 pp, describes dynamic control systems designed to program and regulate one or a number of transient variables in a process with high accuracy. Although this bulletin's main emphasis is on aeronautical testing, application information and diagrammatic illustrations show how transients may be controlled in processing. CDC Control Services, Inc.

103 Pneumatic Control — Bulletin A130, 44 pp, on pneumatic control instruments, discusses general automatic control theory in detail. Describes in simplified terms and illustrations basic concepts of narrow band, proportional, reset, derivative, and reset plus derivative control actions. Also covered are selective control, cascade control, and ratio control. Descriptions of pneumatic recording and indicating controllers are included, as well as data on sensing elements, final control elements, accessories. The Bristol Co.

104 Instruments and Controls — Twelve-pp Publication 57-687-297 provides a digest of specifications of company's instruments and controls. Covers pressure, flow, temperature, level, and gas analysis instruments. Fully illustrated, includes selection chart. The Hays Corp.

105 Pressure Regulators — Form 1011, on flow regulators, provides selection data with photos on three principal types of main valves and pilots. Also illustrated by line drawings are three suggested applications of regulators. A steam capacity table for the selection of main valve size is also shown. Spence Engineering Co., Inc.

106 Flow Meter Selection — Bulletin 110 offers a handy means of selecting the proper flow meter. A die cut disk serves to indicate pressure and temperature limitations of company's rotameters as well as their flow capacity ranges. The indicated meter in turn is tied into brief description on an opposite page with references to more detailed literature. Brooks Rotameter Co.

107 For Temperature Monitoring — Bulletin 72, 8 pp, on temperature monitoring systems, describes various standard sub-assemblies and their arrangement to form one, fully integrated temperature monitoring system for capacities to several hundred points. Individual components are illustrated and a diagram shows how they are adapted to meet individual needs. Bulletin also gives operational details, specifications. Thermo Electric Co., Inc.

108 Air Rate Indicator — The Air Rate Indicator Letter contains complete details on company's line of air rate indicators featuring packless or O ring sealed valves. Further details on the packless valves, which are available with toggle or screw type actuators, are given in Bulletin 1000 and Supplement 1. George W. Dahl Co., Inc.

109 Malfunction Detector — A device that protects rotating and reciprocating machinery by anticipating any malfunction is described in Bulletin 600-1. Describes different models, typical applications, and includes specifications and ordering information. Fielden Instrument Div., Robertshaw-Fulton Controls Co.

110 pH Electrodes — Eight-pp Bulletin 86-5 features pH electodes for laboratory and portable pH meters. Bulletin is written in simplified chart form, indexed and illustrated, designed to aid in selecting of correct electrodes. This is one of a five-bulletin package including information on several pH meters. Scientific Instruments Div., Beckman Instruments, Inc.

MECHANICAL POWER TRANSMISSION

111 Parallel-Shaft Gearmotors — Bulletin 60–2 is a 24-pp booklet covering company's expanded line of parallel shaft gearmotors in built-in and motor-coupled types. Profusely illustrated, bulletin provides full descriptions and specifications for units from ½ to 60 hp. Load capacity and torque tables are included, also drawings illustrating standard mounting positions. Electra Motors Inc.

112 What's In a V-Belt? — Informative little 16-pp Booklet S-51105 describes raw materials used in producing V-belts. Natural and synthetic rubbers, cotton and synthetic cords, rubber chemicals and steel cables used in company's line are subjects for explanations of each material's role in the final product. Goodyear Tire & Rubber Co.

113 Variable Speed Belts — Eight-pp Bulletin 1640-B1 P gives features of the Worthington-Goodyear variable speed belts, listing sizes and providing an interchange list showing number of the belt corresponding with other manufacturers' belts. Key to number coding for V-belt identification is also provided in the bulletin. Worthington Corp.

PUMPS, COMPRESSORS

114 Controlled Volume Pumps — Bulletin 553–1, 32 pp, gives specifications and design features of company's motor-driven controlled volume pumps designed for precise metering and pumping of corrosive liquids against pressure. Standard and modified models and their applications are shown. A section is devoted to useful data and charts with recommendations for materials selection and usage, other reference information. Milton Roy Co.

115 Screw Pump — Six-pp Bulletin S-206 describes basic construction and design of a line of standard screw pumps, double external bearing and gear type, and double external bearing and gear hopper type. Features are illustrated through cutaway views and approximate dimensions are tabulated. Warren Pumps, Inc.

116 Flow Control — Twelve-pp Catalog 800 describes four basic models of precision proportioning pumps for uses requiring accurate and positive proportioning of flow in range of 0 to 730 gph. Materials of construction, capacities and pressures are shown for each. Diaphragm valves are discussed and their features noted. A section on plastic valves and diaphragms features plastic valves for temperatures to 300 F, and includes diaphragm material chart covering diaphragm selection. Hills-McCanna Co.

117 Plastic Pumps — Versatility of service which plastics offer to designers of heavy duty pumps is pointed out in a bulletin entitled "Tough Pumps For Tough Jobs." A table listing characteristics of selected plastics is included. Vanton Pump & Equipment Corp.

118 Air for Industry — Bulletin M-81, is a 44-pp engineering catalog on company's M-line industrial air compressors. Gives capacities, specifications and typical data for air requirements from 200 to 2000 hp. Generously illustrated with photos, cutaways and sketches, this book discusses design features, major components, automatic control, lubrication system, motors and drives. Four models are presented in detail, along with space plans and dimensions. The Cooper-Bessemer Corp.

119 Air Compressors — Engineering data on company's Channel-flo motor-compressor featuring balanced opposed piston construction are presented in 8-pp Form 1547. Details of design and operation are illustrated with photos, drawings and a cutaway view, and specifications are included. Ingersoll-Rand.

New and revised publications reviewed on these pages offer help on operating and maintenance problems. To order, use the handy Reader Service Cards provided on pages 123–124.

120 Diesel-Engine Compressors — Integrally-built diesel-engine compressors are shown in 8-pp Form 3207. The unit featured combines a four-cycle V-angle heavy duty diesel engine and the slow speed horizontal compressor on a single crankshaft without use of coupling mechanism. Advantages and design features are discussed. Ingersoll-Rand.

SEALS

122 Oil Seals — Catalog 856-C, 68 pp, lists oil seals carried in stock with accompanying stock numbers and C/R part numbers. Prefacing listings is a section on materials available for use as sealing members, including Sirvis leather, Sirvis-Conpor (elastomer impregnated) leather which permits self-lubrication without

leakage, and Sirvene (synthetic rubber) compounds. Engineering section covers shaft material, finish, hardness, shaft size and tolerance, shaft speeds, eccentricity, pressure and lubrication. Installation procedure and diagrams included. Chicago Rawhide Mfg. Co.

123 Feed Pump Seals — Detailed information on mechanical seals and sealing systems for boiler feed pumps, also other hot water pumps, is contained in Form 8-230. Gives information on economies obtained as well as technical and installation data. Seals and systems described are engineered to the operation, including adaptation to pump design and piping arrangement. Crane Packing Co.

ELECTRICAL

124 Motors and Drives — Bulletin A-2501, 8 pp, illustrates and describes advantages of company's line of motors and drives. Various models in the line are pictured and short descriptions of design and operation characteristics given. Reliance Electric and Engineering Co.

125 Distribution Transformers — Sixteen-pp Bulletin 61B6014C covers distribution transformers for industrial and rural substations, 75 through 500 kva, 67 kv and below. Describes materials and various production steps used in producing this type of transformer. Includes summary of weights and dimensions along with outline drawings, and EEI-NEMA standard accessories for various sizes. Allis-Chalmers Mfg. Co.

126 High Frequency Transformers — Bulletin P257H, 28 pp, offers features, ratings and complete data on company's standard line of variable transformers for high frequency applications. Gives full information on 35 types of miniaturized manual and motor-driven transformers for 28, 120, 240 and 480-v, single and three phase service in ratings from 56 va to 8.7 kva. Outline dimensions included. The Superior Electric Co.

127 On Control Centers — This 16-pp manual contains descriptive and pictorial information on manufacturer's line of control centers. Special attention is given to planning the control center by means of a step-by-step "do it yourself" guide to writing the specification for a particular control center. Square D Co.

128 Motor Control Center — Bulletin GEA-6367A, 24 pp, describes a compactly designed general-purpose motor control center which permits savings up to 50 per cent in floor area. Construction and application are detailed and ratings, dimensions, installation data and guide form specifications listed. General Electric Co.

129 Aluminum Bus Conductor — Properties and uses of aluminum bus conductors are detailed in this 280-pp handbook, which presents facts and figures vital to engineering and maintenance of bus installations. It contains 69 graphs, tables and photos, presenting essential information in readily usable tabulated form. Introductory material traces development of aluminum's use and its properties as a conductor. Subsequent chapters deal with conductor shapes, design, reactance, capacities, deflections, joints and short-circuit conditions, and fundamentals of installation. Bibliography of related literature is included. Available to qualified power engineers. Please state your job title. Aluminum Company of America.

130 Heavy Duty Relays — Complete information about company's line of IMP (interchangeable multiple pole) and FMP (fixed multiple pole) heavy duty relays is contained in this 8-pp bulletin. Diagrams and dimensional drawings, as well as photos, and specifications included. The Arrow-Hart & Hegeman Electric Co.

131 Battery, Power Connectors — Catalog GB6, 32 pp, contains information on battery connectors, power connectors, and heavy duty connectors for industrial and allied applications. A variety of applications are illustrated and described and photos and dimensional diagrams of plugs and receptacles are included. Cannon Electric Co.

132 Power for Protection — Form D721, 8 pp, tells, through pictures and installation stories, how company's diesel electric sets help maintain electrical power during emergencies. The full line of standby electric sets is listed with hp and kilowatt ratings. Caterpillar Tractor Co.

WATER, WASTE HANDLING

133 Water Treatment Systems — Three protective treatments for water supply systems — potable water treatment, sweet water treatment and brine water treatment — are described in this illustrated bulletin. Complete details of application and control are included. Western Chemical Co.

134 Valveless Filter — Operation of company's automatic valveless filter is described in this 8-pp illustrated bulletin. Applications and typical operating conditions are detailed and diagrams and photos are included. The Permutit Co.

135 Waste Treatment Equipment — A general description of company's line of waste treatment equipment is contained in 8-pp Bulletin 315-11. It outlines various methods of treatment, including screening, grit removal, sludge removal, settling, skimming, flocculation, and flotation. Equipment for sewage or industrial plants is covered. Chain Belt Co.

PIPING, TUBING, FITTINGS

136 On Plastic Pipe — Containing latest technical information on pressure-rated plastic pipe and fittings, this 8-pp booklet includes complete tables on pressure drop through plastic pipe, pressure-temperature ratings for different sizes, and recommended pumping depths. Figures are given on three grades of polyethylene pipe: standard wall, 75-lb and 100-lb. Booklet provides pictures of plastic pipe installations and explains installation procedure. Crane Co.

137 PVC Pipe, Fittings — Bulletin PE-40, 12 pp, describes physical properties and chemical resistance of company's PVC pipe and fittings designed for process industries. Plumbing and installation data is included, as well as pipe and fitting dimensions, valve dimensions, and information on Pyrex brand process equipment. Corning Glass Works.

138 On Steel Piping — Provided in Technical Data Card 138-B are two tables, one listing dimensional data for 16 sizes of pipe from ⅛ to 8 in. nominal size for six different weight schedules showing outer and inner diameters, wall thickness and weights per foot. The other table covers ASTM, ASME specifications, showing title, grade, type, and analysis for various carbon, alloy and stainless steel pipe used for high temperature, high pressure and other services. The Tubular Products Div., The Babcock & Wilcox Co.

139 Pipe Fabrication — "How Piping is Fabricated" is the title of this 16-pp bulletin, which illustrates equipment, materials and processes, including pipe bending facilities, welders, x-ray machines, heat-treating furnaces, pipe and fittings inventories and other facilities for accurate, quality piping fabrication. The Flori Pipe Co.

140 Friction Calculator — This pocket slide calculator gives data for figuring water pipe and paper stock pipe friction losses. Data for water pipe are based on standards of the Hydraulic Institute. Those for determining paper stock pipe friction loss, shown on the opposite side of the calculator, are based on test data. This practical tool also carries a table of equivalent lengths of new straight pipe for valves and fittings for turbulent flow. Allis-Chalmers Mfg. Co.

141 Steel Tubing Tolerances — Covered on this convenient data chart are tolerances for both seamless and welded mechanical tubing, and seamless and welded stainless steel tubing and pipe. Explains tolerances in detail and gives permissible variations in OD and ID, wall, ovality. Peter A. Frasse & Co., Inc.

142 Pipe and Tubing Manual — Products from ⅛ to 40 in. OD are described in this 48-pp book. Full color photos show company's production and quality control procedures and the story of company's Contour Trentweld is told briefly. Separate sections deal with pipe and tubing for high pressure applications, beverage and dairy equipment, mechanical equipment, others. Also shown is large diameter tubing for pulp mill stock lines, waste disposal systems in chemical industries, exhaust stacks etc. A section is devoted to titanium tubing. Tables cover size ranges, corrosion. Trent Tube Co.

143 On Packaged Fittings — Data on a new packaging concept for forged steel pipe fittings are presented in Bulletin PF-1-57. Gives quantities of each type and size of each fitting packed in the various sizes of cartons; dimensions of each carton and weights. This packaging system of unit cardboard cartons within larger shipping cases is reported to protect fittings in transit and provide means of stocking. W-S Fittings Div., H. K. Porter Co.

144 Welding Outlets — Couplets — easily installed, branch connections for tanks, pressure vessels and pipelines — are described in Bulletin CP-1-57. Provides complete dimensional and specification data on screw-end and socket-welding types and on a 90-deg elbow Couplet. Installation details are included. W-S Fittings Div., H. K. Porter Co., Inc.

VALVES, TRAPS, STRAINERS

145 Brass Valves — Described in this folder are brass composition-disc globe, angle, and lift check valves. Folder emphasizes advantages of these valves for a broad range of services, including steam, water, air, oil, gas and gasoline. Shows in pictures the ease with which the quick-change composition disc may be replaced, without removing the valve body from the line. Also shows other design features and gives sizes and dimensions. Crane Co.

Mead-Morrison

means **modern** *material handling*

When you buy a Mead-Morrison Tower, you can be sure of MODERN design to meet today's demands for effective design and efficient operation. Note these Mead-Morrison characteristics:

Sturdy Construction . . . demonstrated by the many installations that are giving trouble-free service year after year,

Speedy Unloading . . . exceeding the specified hourly rate in many cases,

Simple Operation . . . all grab movements controlled by only 2 conveniently arranged latched levers,

Smooth Control . . . new standards of ease and smoothness in both free digging and clean-up,

Specially Engineered for Each Installation . . . by a long experienced organization backed by complete manufacturing experience.

Mead-Morrison engineers will be glad to help you plan your new unloading facilities or give advice on increasing the capacity of your present equipment.

Mead-Morrison Rope Trolley Stationary Coal Barge Unloading Tower recently installed at the Meramec, St. Louis, Plant of the Union Electric Company of Missouri. The tower has a capacity of 600 tons per hour (throughout a barge), and is equipped with a 7-ton Mead-Morrison Grab Bucket. The plant also has a Mead-Morrison Barge Haul System which works in conjunction with the tower.

MEAD-MORRISON

Division of McKIERNAN-TERRY CORPORATION

Builders of Coal and Ore Towers and Bridges, Grab Buckets, Pile Hammers, and Special Machinery

HARRISON, NEW JERSEY

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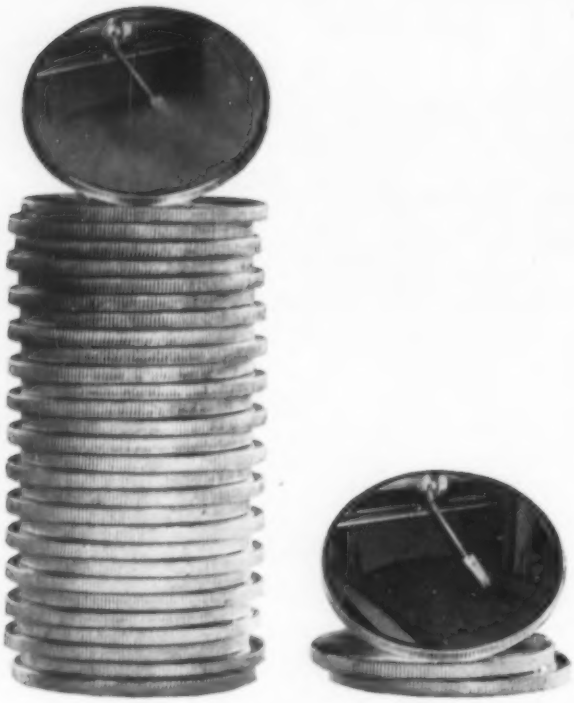

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A CHEM-JET SYSTEM COSTS ONLY 1/10 AS MUCH AS OTHER METHODS

A Chem-Jet Liquid Dust *Control* System can be job-engineered and installed in your plant for about 10% of the cost of any dust *collection* system. This is not merely an idle claim; it can be proved by actual dollar comparisons.

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1724 Chestnut Street, Philadelphia 3, Pa.

CANADIAN REPRESENTATIVES: G. F. Sterne and Sons, Ltd., Brantford, Ontario

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146 **Relief, Back Pressure Valves** — Bulletin 357 describes company's chemical relief valves and back pressure valves. Gives complete specifications including capacities of 4 standard sizes — ¼, ½, ¾ and 1 in. Dimensions and materials of construction are detailed. Milton Roy Co.

147 **Engine Stop Valve** — Eight-pp Bulletin S-3A describes company's cushioned automatic engine stop valve designed to automatically shut down the turbine, compressor, or engine in the event of overspeed or runaway. Provides typical installation diagrams, shows various tripping mechanisms, explains sequence of operation. Includes parts list, dimensions. Golden-Anderson Valve Specialty Co.

148 **Steam Specialties Guide** — Sixty-pp Catalog 69 contains descriptions, illustrations, dimensions, capacities and prices covering steam traps, strainers, separators, flash separators, reducing valves, block steel valves and engine stops. Condensed tables give concise presentation of steam trap pressures, capacities and orifice sizes. Other features of the book include "how to" pages on selection, sizing and installation of traps; illustrated parts breakdowns; tips on steam trap trouble shooting. Company's Hydro-Flex line of traps is covered in detail, including explanation of operating principle. Strong, Carlisle & Hammond.

COOLING, HEAT EXCHANGING

149 **Heat Exchangers** — This 16-pp revised catalog presents data on shell and tube heat exchangers for a wide range process, refinery and power plant application. Bulletin features an engineering section giving practical suggestions on determining heat exchanger requirements. Space is also devoted to thermal standards and reference data, and information on floating head, removable bundle designs is included. Condenser Service & Engineering Co., Inc.

150 **Oil Coolers** — Bulletin 12C describes single- and two-pass oil coolers for cooling fluids in lubricating, power and processing applications. Includes data on design and operating features, material specifications, sizes and dimensions, plus a handy sizing guide. A nomograph for determining logarithmic mean temperature difference, together with simplified design equations permits rapid approximation of unit for the job. Schutte and Koerting Co.

HOSE, ASSEMBLIES

151 **Flexible Metal Hose** — Catalog ID-100A is a 12-pp condensed catalog on flexible metal hose. An excellent reference book, it gives recommended pressures, temperatures and specific uses for which each type is suited. Various types are described and illustrated, including seamless, corrugated type and interlocked type, with or without packing, as well as styles of couplings. Universal Metal Hose Co.

152 **Water Suction, Steam Hose** — These two catalog sections describe company's lines of water suction and steam hose. Operating data and specifications on five types of water suction hose for industrial use are covered in one section. The second covers five types of steam hose. B. F. Goodrich Industrial Products Co.

153 **Hose and Retractable Duct** — Eight-pp Bulletin 70 gives prices and complete information on company's hose and

~~Kill Algae~~

Get SAFE, QUICK CONTROL at Low Cost

Allis-Chalmers No. 120 Series Algaecide eliminates fouling of cooling tower systems by algae and slimes

Check the many exclusive advantages of Allis-Chalmers No. 120 Series algaecide:

- Easy to introduce into the system by means of pump, drip feed or manual feed. No expensive feeding equipment required.
- Safe to handle. Even in concentrated form, it is no more than a mild irritant to skin, eyes and mucous membranes.
- Low toxicity to fish or animals.
- Non-oxidizing.
- Inhibits corrosion.
- Dosage is independent of organic, ammonia, or nitrogen content of makeup water.
- No loss on passage through tower.
- Proved effective in field use.
- Only 2 to 5 ppm required for effective dosage of most organisms.

This is the most effective algaecide known. If you have a problem with plugged pump strainers, coated heat exchanger tubes, coated slats in cooling towers, call your nearby A-C office, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin, for Bulletin 28X8434.

ALLIS-CHALMERS

A-5442

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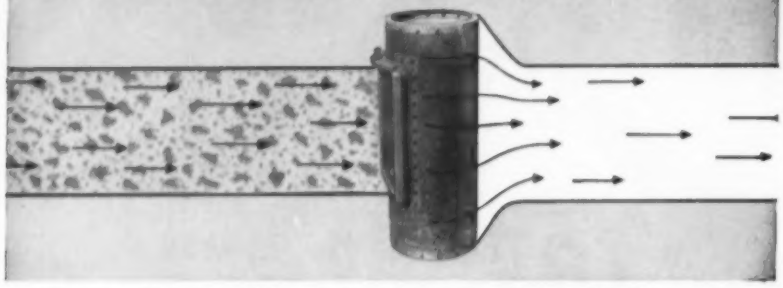
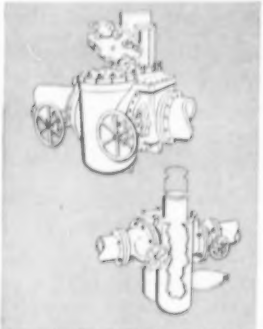
ELLIOTT STRAINERS

assure "trouble-free" clean liquids



For over 50 years, Elliott strainers have proved themselves in power and industrial plants everywhere. Removing objectionable solids that could cost thousands of dollars in lost time and damaged equipment, they keep liquids clean and free of foreign matter.

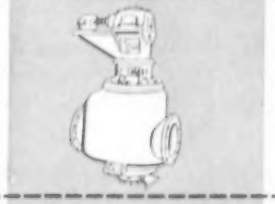


ELLIOTT TWIN STRAINERS
TYPE A, for water and other liquids

Provides continuous flow, since one strainer basket is in service while the other is removed and cleaned. Available sizes 4" to 24" for 125 psi, and 4" to 12" for 250 psi pressure. Straining-basket mesh ranges from 1/32" to 3/8". Also available: back-flushing strainers in manually-operated and rotary spray types, sizes 4" to 24".

TYPE V, for lube oil, fuel oil, viscous liquids

Uses large-size baskets to facilitate unrestricted fluid straining. Sizes from 1" to 8" for 125 psi, 1 1/2" to 10" for 300 or 500 psi, straining perforations from 3/8" down to fine wire mesh.



TYPE K SELF-CLEANING STRAINER
for removing large amounts of foreign matter in water

Cleans itself automatically and continuously by back-flushing the straining units. Standard sizes 4" to 24", pressures 25 to 125 psi, straining units 1/32" to 3/8" mesh. Available with AC or DC motor, low power requirement.

TYPE F SINGLE STRAINER
where flow can be interrupted for cleaning

Excellent for liquids not containing large amounts of foreign matter, or batch processes. Quick-opening cover. Sizes 2" to 24" for pressures up to 125 psi, basket mesh 1/32" to 3/8".

For further details, call your nearby Elliott District Office or write Elliott Company, Accessories Department, Jeannette, Pa.

A7-3

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retractable duct. Photos illustrate applications and methods of cutting, bending and coupling. Selection data included. The Flexaust Co.

154 Hose Ends, Assemblies — This 40-pp catalog incorporates detailed information on bulk industrial hose, permanently attached hose assemblies, swaged hose assemblies and ends, hose end swivel adapters, assembly instructions and installation data. Charts for hose agent selection, hose specifications and hose end identification are included, as well as data on maximum working pressure, proof-test pressure, minimum burst pressure, tube materials, reinforcement, temperature range and types of hose ends, and detailed assembly instructions for reusable hose ends. The Weatherhead Co.

INSULATION

155 Insulation Specifications — This set of six specifications covers application of Foamglas insulation for industrial equipment and piping. Each booklet contains tables of suggested thicknesses, detailed drawings of installation procedures, insulation supports and recommended finishes. Booklets cover: low temp equipment and piping (below 70 F); medium temp equipment and piping (70 to 212 F); high temp equipment and piping (over 212 F); dual temp equipment and piping (−300 to 400 F); underground piping; and insulation on spheres. Pittsburgh Corning Corp.

156 Pipe Insulation — Specifications for Mono-Kover, a slit, one-piece, sectional type mineral wool pipe insulation that snaps into place, are presented in this bulletin. Besides describing insulation properties of the material, bulletin explains and illustrates application methods. Thermal conductivity is shown for temperatures throughout operating range (to 350 F). Available facings are listed, and tables give thicknesses recommended to insulate pipe sizes from 3/4 to 24 in., according to temperature and type of application. Baldwin-Hill Co.

VENTILATING AND AIR CONDITIONING

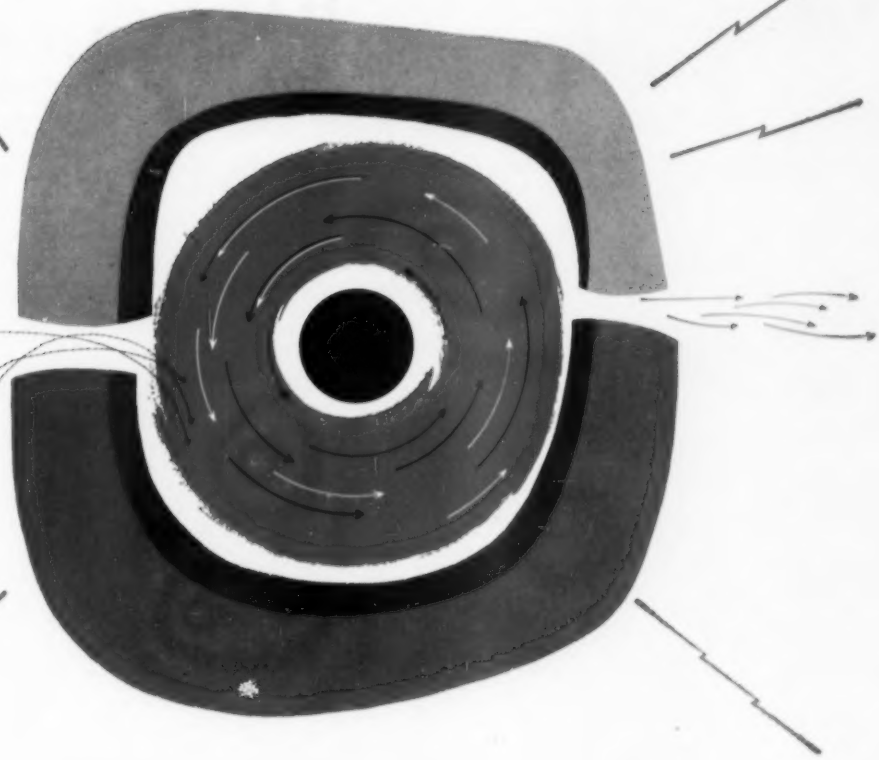
157 Utility Sets — Bulletin 8314, 52 pp, on company's Sirocco utility sets, illustrates and describes various size ranges and configurations of fan wheels and motors available. Features and advantages of the units are explained. Among selection criteria discussed are space volume, quantity of fresh air required, altitude and temperature correction, outlet velocity, duct size, static pressure and tip speed. Capacity tables are included, giving motor horsepower, fan speed range and delivery for a variety of static pressures. Installation type drawings show dimensions. American Blower Div., American-Standard.

158 Air Diffusion Equipment — Catalog 1-57, 66 pp, describes and illustrates company's complete line of grilles and registers. Profusely illustrated with photos and dimensional diagrams, the book contains complete engineering data, including size selector chart and other information for each of the 26 standard sizes. Waterloo Register Co., Inc.

159 Air Conditioners — Twenty-pp Bulletin 6125, on packaged air conditioners, describes 1957 models in 3- to 20-ton capacities. Design features are detailed

call KE for plant expansion or new facilities

INGENUITY



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A 475,000 KW power generating facility, engineered and built by KE.

Faster construction, more efficient operation, lower costs—these are benefits Kaiser Engineers' ingenuity has brought to power projects ranging from America's largest dam to power installations for industrial plants.

Experienced KE engineers can take your power idea from a gleam in your eye through start-up—from economic analysis through operator training.

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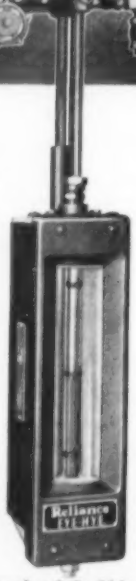
EYE-HYE

gives quick, accurate boiler water level reading for each drum at new automotive plant

Close-up of one of three panels shown below, in power plant of Chrysler Stamping Plant, Twinsburg, Ohio.



Here, as in thousands of other plants, operators "keep tab" on boiler water levels easily, quickly — with EYE-HYE conveniently mounted on panel or wall where wanted.

EYE-HYE is simple, safe, sure — easy to read from its illuminated green indicating liquid. It is sensitive to slightest level changes. Has no mechanical parts — is completely hydrostatic. Set at factory for the boiler it's ordered for; no adjustments or tampering possible on location. EYE-HYEs are available for any boiler pressure.

As an extra precaution, if warning signals are wanted, EYE-HYE can be equipped to actuate auxiliary lights and/or horns in various parts of the plant.

There are many uses for EYE-HYE Remote Reading Gages. Besides the main boilers, it can do valuable service on feed water heaters, waste heat boilers, flash tanks, storage tanks, etc. When writing for information, mention your working steam pressure.

The Reliance Gauge Column Co., 5902 Carnegie Ave., Cleveland 3, Ohio

Reliance EYE-HYE
Remote Reading Gage
All-hydrostatic - Reads like a tubular glass gage

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and illustrated and operating components discussed. Physical data for the units and major components are given. Engineering data provided includes capacity curves, fan performance tables, recommendations for V-belt drive selection for low, standard and high speed fan operation in each unit, pressure drop tables etc. Also included are curves for finding condenser water required for various conditions. American Blower Div., American Standard.

160 Packaged Water Chillers — Two new series of Flow-Pac water chillers — small tonnage air conditioners and industrial liquid chillers — are described in 6-pp Catalog 560. Covers complete mechanical specifications, water temperature ranges, Btu capacities, pressure drop data and applications. Acme Industries, Inc.

OTHER EQUIPMENT

161 Self-Contained Boilers — Bulletin AD-162, 8 pp, describes company's complete line of self-contained boilers for heating and processing steam or hot water. Design features and advantages are detailed and a cutaway view showing flow of air in the forced draft system is included. Cleaver-Brooks Co.

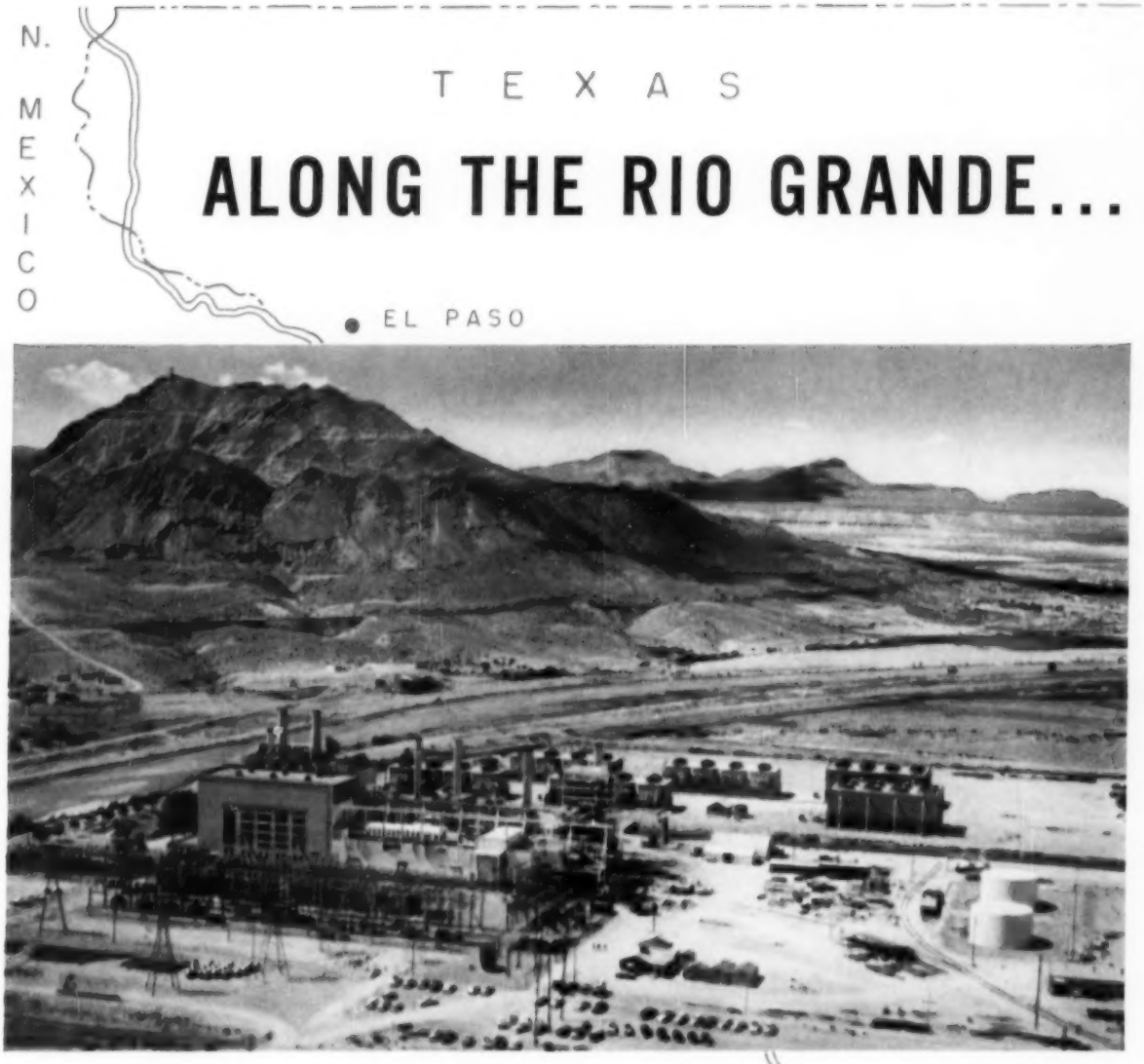
162 Looking for Good Films? — Booklet B-7077, 28 pp, is a catalog of 47 general interest films, product information films and training films available from this company without charge. The 16-mm films are for use by professional, business, civic and other groups. Also included in booklet is a description of instruction courses available to electric utility companies. Westinghouse Electric Co.

163 On Lubrication Problems — "Breaking Lubrication Barriers," Bulletin 110, is a 16-pp brochure covering history and development of Molykote line of molybdenum disulfide lubricants. Bulletin covers physical and chemical properties of compound as well as providing charts which show its superior lubricity. Selection table, application photos are included, as well as a section on bonded solid film lubricating coatings. The Alpha Molykote Corp.

164 Hazard Finder — To locate the hidden probabilities of electrically ignited explosions in plants, this "Hazard Finder" is offered. An 8-pp folder, it contains a check list of 13 questions that can help determine whether uncontrolled flammable gases, vapors, dusts, liquids and other combustible materials are making a plant unsafe. An evaluation of hazard potential is revealed after the questions have been answered. Crouse Hinds Co.

165 Choosing Pumping Power — Form DE716 is a 12-pp handbook on selecting power for pumping. It contains a checklist of features necessary for continued dependable operation on pumping jobs. Step-by-step, this list covers requirements which an engine must have, accompanying them with illustrations and examples of efficient installations. Caterpillar Tractor Co.

166 Ramfeed Stokers — Bulletin 456, 12 pp, illustrates and describes advantages of company's Lo-set ramfeed stokers. Prominent attention is given to the synchronized combustion controls that keep coal feed, forced air and stack draft in positive balance. Turbo-aire, a system for smoke control, is also explained, as well as the Binfed-Ramfeed stoker that conveys coal direct from storage to furnace without labor. Canton Stoker Corp.



ALONG THE RIO GRANDE...

The Southwest has become one of the centers of national defense. Here, served by the Rio Grande Station of the El Paso Electric Company, are Fort Bliss, Beaumont General Army Hospital, Biggs Field, White Sands Proving Grounds, Holloman Air Development Center and many strategic industrial firms.

Stone & Webster Engineering Corporation designed and built the original Rio Grande Station which produced 49,000 kilowatts, as well as subsequent additions that raised its capability to 200,000 kilowatts. Currently Stone & Webster is installing another unit with a capability of 50,000 kilowatts which is scheduled to go on the line next year.

Write or call us for information as to how our experience may be of assistance to you.

STONE & WEBSTER ENGINEERING CORPORATION

A SUBSIDIARY of STONE & WEBSTER, INC.

New York • Boston • Chicago • Pittsburgh • Houston • San Francisco • Los Angeles • Seattle • Toronto

How to get maximum combustion efficiency . . . measure <u>both</u> combustibles and oxygen

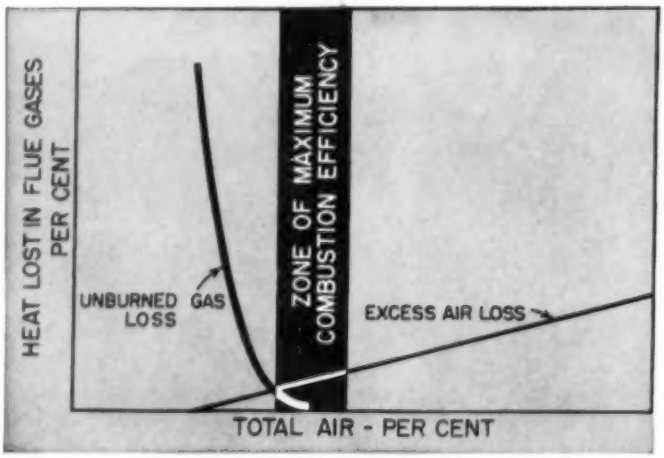
Simultaneous measurement of both oxygen and combustibles is needed to obtain optimum combustion. No instrument that measures only one of these two interdependable factors can give you the full information necessary.

Now, Bailey offers two units, each giving a continuous and simultaneous double check on combustion efficiency: a permanent analyzer-recorder which records both factors on a single chart; and a new light weight, portable unit which indicates both factors.

Both instruments measure: (1) excess air—regardless of the fuel or combinations of fuel being burned, (2) mixing efficiency of your fuel burning equipment by showing per cent combustibles in the flue gas.

Both units are designed to increase efficiency in the furnace operations of the steel industry, on glass tanks, cement and lime kilns, ceramic and refractory kilns, steam boilers and also on direct and indirect-fired furnaces in the metal processing industries.

To prevent your money from becoming waste gas, look into these two efficiency provers. A Bailey engineer will be glad to give you details or write us for product specifications.


HEAT LOST IN FLUE GASES PER CENT
UNBURNED GAS LOSS
ZONE OF MAXIMUM COMBUSTION EFFICIENCY
EXCESS AIR LOSS
TOTAL AIR - PER CENT

Maximum Combustion Efficiency is secured by keeping the sum of Excess Air Loss and Unburned Gas Loss to a minimum. To do so by the direct method simply measure both oxygen and combustibles in flue gas.

For portable use—
HEAT PROVER Analyzer

The famous Cities Service HEAT PROVER analyzer is now Bailey built and sold. Weighing only 25 pounds, it is a self-contained automatic analyzer including a sampling tip and hose plus a thermocouple for temperature measurement.

Instrument dials are dual range for greater accuracy and sensitivity.

For permanent installation
Oxygen-Combustibles Recorder

The Bailey Oxygen-Combustibles Analyzer-Recorder coordinates both records on one chart. These records enable the operator to keep fuel burning equipment performing continuously in the zone of maximum combustion efficiency. Excess air may be reduced to the point where combustibles begin to show.

G 40-1

Instruments and controls for power and process

BAILEY METER COMPANY

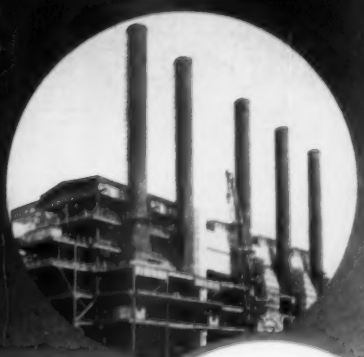
1040 IVANHOE ROAD • CLEVELAND 10, OHIO

In Canada—Bailey Meter Company Limited, Montreal

BAILEY METERS

For more data circle 522 on Post Card

ATLAS LUMNITE* lengthens stack life



GUNITED STACKS AND BREECHINGS at Linden, N. J., generating station of Public Service Electric and Gas Co. (Newark) are among the growing number of power-plant installations using concrete linings made with Lumnite cement. From ash hoppers to stacks, Lumnite linings reduce maintenance costs and provide long service life.

- Lumnite-made industrial concretes give rugged resistance to heat, corrosion, abrasion and thermal shock.
- Placement is fast and easy—by guniting, pouring or plastering.
- Downtime is reduced to a minimum—service strength is reached within 24 hours.

For maximum convenience, use Lumnite-made castables. These are packaged mixtures, ready for use. Just add water, mix and place. Made and distributed by leading manufacturers of refractories.

For more information, write: Universal Atlas, 100 Park Avenue, New York 17, N. Y.

UNIVERSAL ATLAS CEMENTS

USS

* **"LUMNITE"** *is the registered trademark of the calcium-aluminate cement manufactured by Universal Atlas Cement Company.*

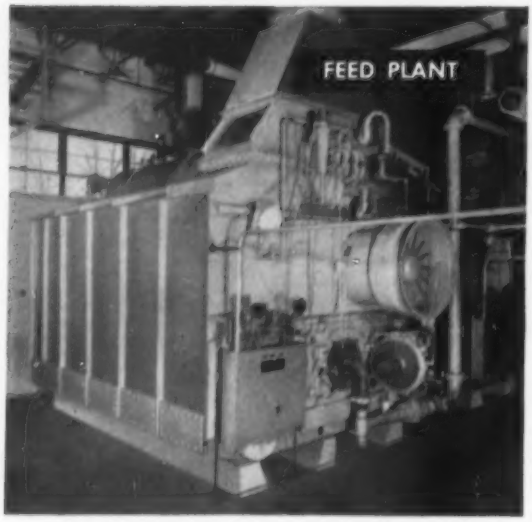
L-154

UNIVERSAL ATLAS CEMENT COMPANY—member of the industrial family that serves the nation—**UNITED STATES STEEL**

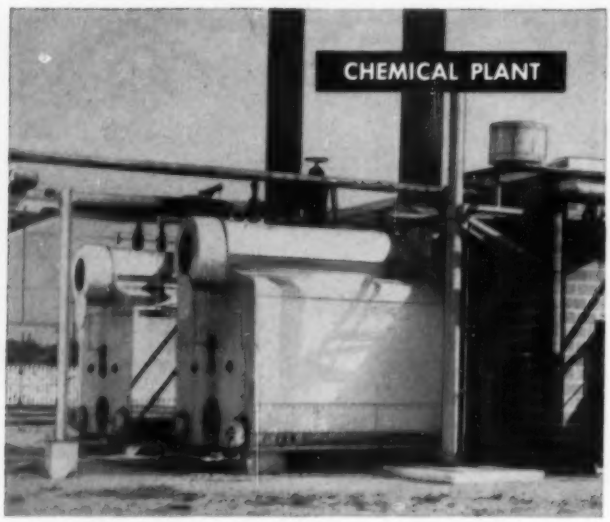
OFFICES: *Albany · Birmingham · Boston · Chicago · Dayton · Kansas City · Milwaukee · Minneapolis · New York · Philadelphia · Pittsburgh · St. Louis · Waco*

For more data circle 523 on Post Card

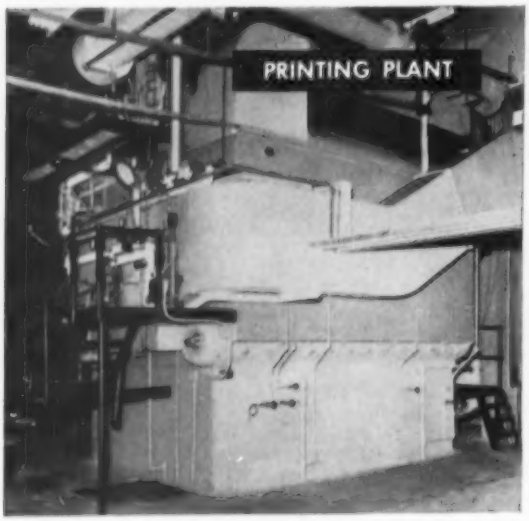
Here's how industries are profiting



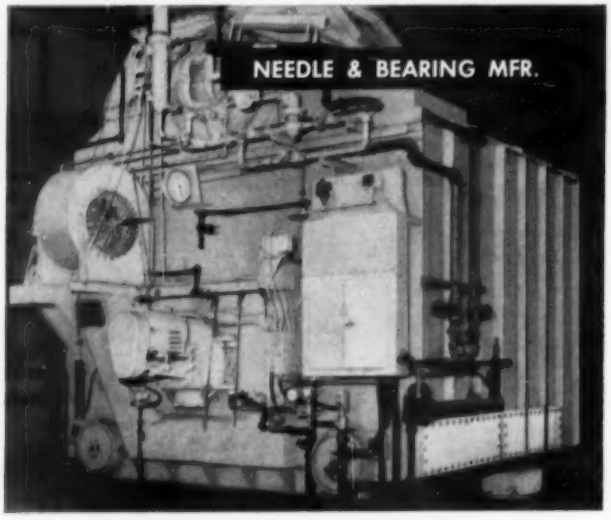
PROVED "DEPENDABLE" IN MODERN FEED PLANT
Playing a dual role in the manufacture of livestock and poultry feed, this is one of two Union Type MH Steam Generators producing steam for processing milk by-products and for providing space heat. Selected "on the basis of good design" by Consolidated Products Co. for its Springfield, Mo. plant, these 22,000 lb./hr. packaged units are reported to "have proven very satisfactory and dependable sources of steam."



"EFFICIENCY HIGH" ON OUTDOOR ASSIGNMENT
That's what Davison Chemical Company, Division of W.R. Grace & Co., has to say about these two Union Type MH Steam Generators. Delivering process steam, this pair of 18,000 lb./hr. packaged boilers handles an important job in Davison's large Lake Charles, La. plant which is equipped to produce approximately 45,000,000 lbs. of petroleum cracking catalysts annually. Selected because of "reputation . . . and delivery," both of the units were shop-assembled in Erie, Pa. before delivery to the job site.

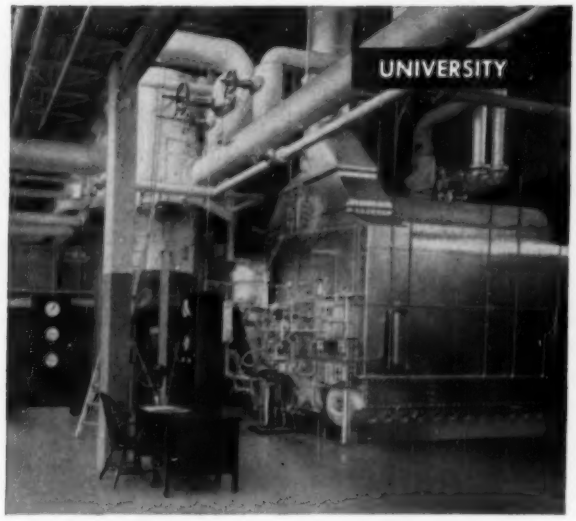


PACKAGED AIR HEATER ADDED FOR 85.79% EFFICIENCY
Here's one of the many ways Union can supply auxiliary equipment with a completely shop-assembled MH Steam Generator to handle special needs formerly requiring costly field erection and special engineering. Serving Western Printing and Lithography Co., this 20,000 lb./hr. unit "has proven very satisfactory." Western also adds, "It was sold to operate at 85% efficiency and is doing that."

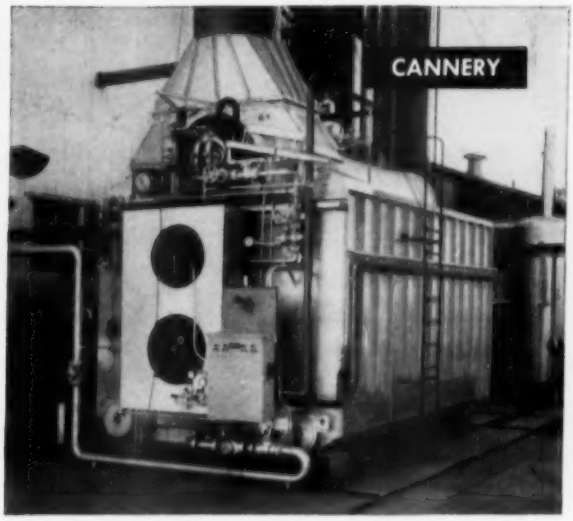


20,000 LB./HR. "MH" SAVES $12,500 IN YEAR
Because "construction and design appeared better than others and physical size fit into plant," a 20,000 lb./hr. Union Type MH Steam Generator was installed in the Excelsior plant of The Torrington Company in October, 1955. In short order, the new boiler proved its worth. When a second MH (15,000 lbs./hr.) was installed in October 1956, Torrington said this about the first: "Estimated savings for the first year are $12,500, as compared to our old coal burning hand fired boilers."

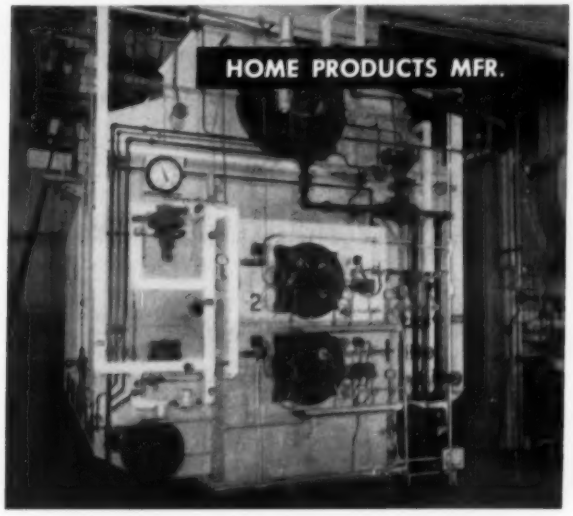
with Union Packaged Boilers



SCORE "BETTER THAN 80%" ON EFFICIENCY TESTS
Providing space heat for 14 buildings on University of Toledo's 170-acre campus, two 28,000 lb./hr. Union Type MH Steam Generators also take part in the educational process. Utilized for laboratory work by mechanical engineering students, these Union Packaged Boilers are reported to operate at "better than 80% efficiency." Says the University, "We get 128 lbs. of steam per gallon of fuel oil as compared to 93 lbs. per gallon with the old boilers formerly used."



ONE "MH" LEADS TO ANOTHER
Tri-Valley Packing Assoc. uses a pair of Union 30,000 lb./hr. Packaged Steam Generators. In 1953, Tri-Valley's first MH Unit went to work in the Association's Modesto plant. When the San Jose plant needed a new boiler in 1955, another Union Packaged Boiler (shown above) was picked for the job. Says Tri-Valley, "Our selection was based upon our evaluation of the design . . . and the performance of the MH Packaged Boiler installed in our Modesto plant."



THRIFTY — LIKE THE PRODUCTS OF ITS USER
On duty at the Easthampton, Mass. plant of Stanley Home Products, Inc., this 35,000 lb./hr. Union MH Steam Generator was selected for "its well-balanced design, neat appearance and adaptability to burning oil, gas or coal" plus the fact that "design and connections permitted the quickest and least costly installation." With the MH operating over a range from 5,000 thru 35,000 lbs./hr., Stanley reports "considerable savings in fuel with an increase in production."

HOW ABOUT YOU?
Like more facts on Union's popular MH? Full details including cut-away illustrations, tube layouts and dimension tables for all 13 sizes (10,000 thru 60,000 lbs./hr.) can be obtained by requesting Bulletin MH-353.

Get the full story by mailing this coupon

UNION

UNION IRON WORKS
ERIE, PENNSYLVANIA

MAIL your illustrated Bulletin MH-353 to us at once.

NAME _____ TITLE _____

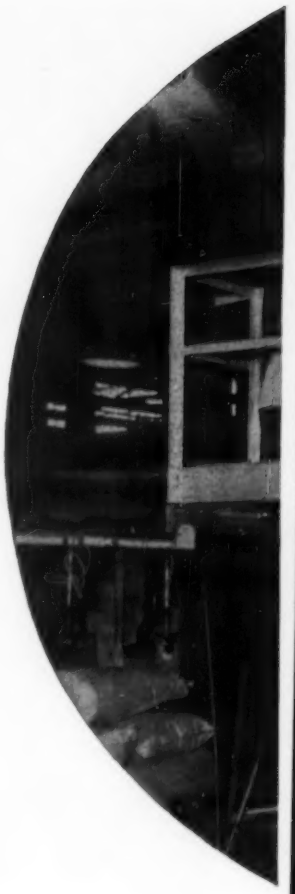
FIRM _____

STREET _____

CITY _____ STATE _____

For more data circle 524 on Post Card

"Our Turbo Air Blowers were often shutdown by motor starting currents . . . *until we changed to Fusetron Fuses*"



"As our Turbo air blowers build up speed there is a back up pressure exerted which puts an overload on the motors. Consequently, it takes longer for the motors to gain normal running speed.

"Frequently, the 100 ampere renewable fuses we were using couldn't hold these overloads—and we would have a shutdown.

"We were anxious to eliminate these down-periods, but we didn't want to sacrifice safe fuse protection on our 30 h. p., 3600 R. P. M., 220 volt, 3 phase, 60 cycle motors that power the Turbo air blowers.

"We decided to protect these motors with 100 ampere Fusetron dual-element fuses. This move proved to be the answer to our problem. Since changing to Fusetron fuses we haven't had any trouble with our Turbo air blowers being 'knocked out' on motor starting currents."

B. D. McGaughey
ELECTRICAL SUPERINTENDENT,
Copperweld Steel Company, Glassport, Pa.

HERE'S HOW FUSETRON FUSES PROTECT AGAINST NEEDLESS BLOWS CAUSED BY HARMLESS OVERLOADS.

Fusetron dual-element fuses will hold motor-starting currents or other harmless overloads without opening because they have a tremendous time-lag.

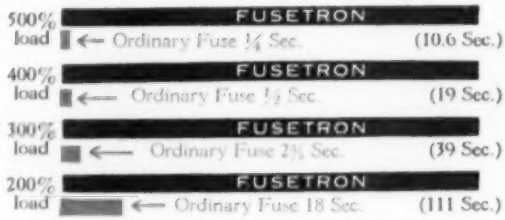
A machine may momentarily stall or be overloaded and Fusetron fuses won't open.

A motor may be started under heavy load—or all the motors on a circuit may be started at once—and Fusetron fuses won't open.

Circuits can be loaded nearer to the capacity of panelboards and switches without having Fusetron fuses open needlessly.

Here's a comparison of time-lag between Fusetron and ordinary fuses

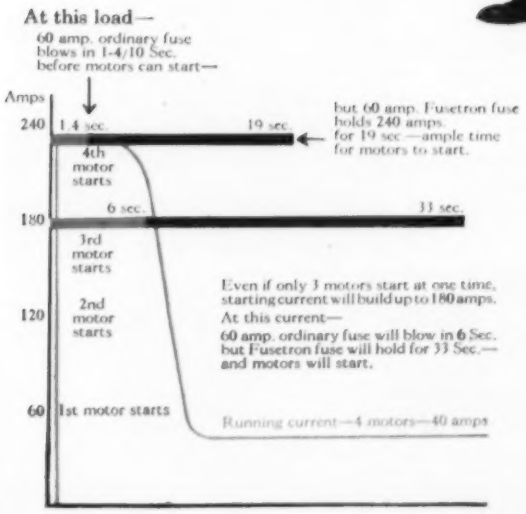
Notice that even at 500% load a Fusetron fuse will hold on for more than 10 seconds—while an ordinary fuse will open in less than ¼ second. Yet, with all this time-lag, there is no sacrifice of safety.



Comparison is based on ordinary fuses with the longest time-lag. Figures apply to 30 amp. 250 volt size. Opening time on larger sizes and on 600 volt sizes is longer.

Here's an example of how Fusetron fuse time-lag works

For example: take four 10 amp. motors on a circuit. 60 amp. ordinary fuses would be used to protect the circuit. BUT see what happens when four motors start at one time. The starting current of each motor is about 60 amps. so the combined starting currents would reach 240 amps.


At this load—
60 amp. ordinary fuse blows in 1-4/10 Sec. before motors can start—
Amps
240
1.4 sec.
19 sec.
but 60 amp. Fusetron fuse holds 240 amps. for 19 sec.—ample time for motors to start.
4th motor starts
180
6 sec.
33 sec.
3rd motor starts
Even if only 3 motors start at one time, starting current will build up to 180 amps.
At this current—
60 amp. ordinary fuse will blow in 6 Sec. but Fusetron fuse will hold for 33 Sec.—and motors will start.
2nd motor starts
120
60
1st motor starts
Running current—4 motors—40 amps

So with Fusetron fuses installed in Mains, Feeders and all Branch circuits—shutdowns caused by needless blowing of fuses are ENTIRELY WIPED OUT.

Don't risk losses! One needless shutdown . . . one lost motor . . . one destroyed switch or panel . . . one burned out solenoid . . . may cost you far more than replacing every ordinary fuse with Fusetron dual-element fuses. Write for bulletin FIS.

For loads above 600 amps.— Use BUSS Hi-Cap Fuses to coordinate your electrical circuits.

On 600 volts or less, BUSS Hi-Cap fuses have an interrupting capacity sufficient to handle any fault current regardless of system growth.

They can be coordinated with Fusetron fuses on feeder and branch circuits to limit fault outages to circuits of origin. Write for bulletin HCS.

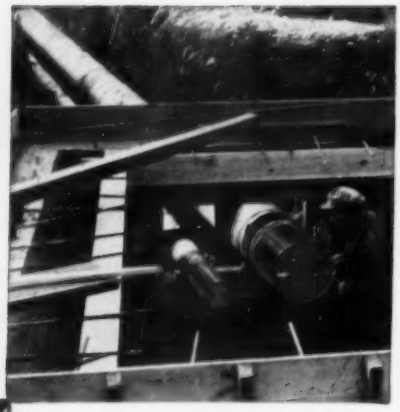
Bussmann Mfg. Division (McGraw-Edison Co.)
University at Jefferson, St. Louis 7, Mo.

Play safe! *install Fusetron dual-element fuses and BUSS Hi-Cap Fuses throughout entire Electrical System!*

For more data circle 525 on Post Card

MR. ENGINEER:
LET'S FACE THE FACTS . . .

How can an underground piping system be watertight when you can't *AIR TEST* it?



Test caps applied to unit ends for air testing full-welded conduit system.

During air test, conduit field welds are checked with soap solution.

WITH

RIC-WIL

Tested and ready for lowering long lengths.

YOU can AIR TEST your system...

The Ric-wil method of making full-welded field closures allows the installer to AIR TEST the system prior to completion and backfilling. This simple 15 lb. pressure test gives greater assurance of a tight, leak-proof system. It provides the finest practicable protection to the owner against an initial system failure ...and most important, the long range effects of water corrosion.

Ask a Ric-wil field representative for detailed information regarding Air Test procedure or write for catalog covering recommended field installation details . . . and remember, it pays to do it RIGHT the first time . . .

Quality Piping Systems . . .
. . . of Exceptionally High Thermal Efficiency
SINCE 1910

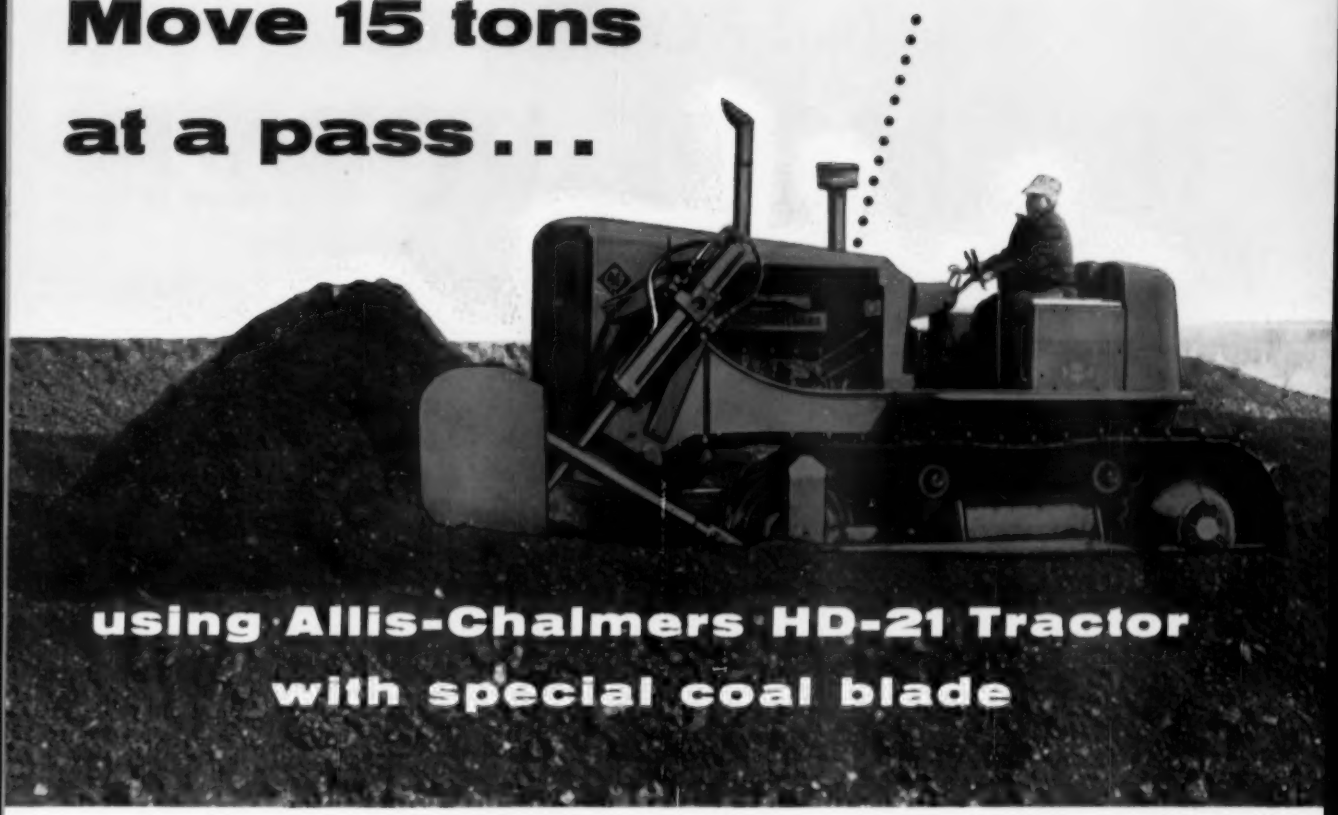
RIC-WIL INCORPORATED — PREFABRICATED INSULATED PIPING SYSTEMS

BARBERTON, OHIO

IN CANADA: THE RIC-WIL COMPANY OF CANADA LIMITED

For more data circle 526 on Post Card

Move 15 tons at a pass . . .



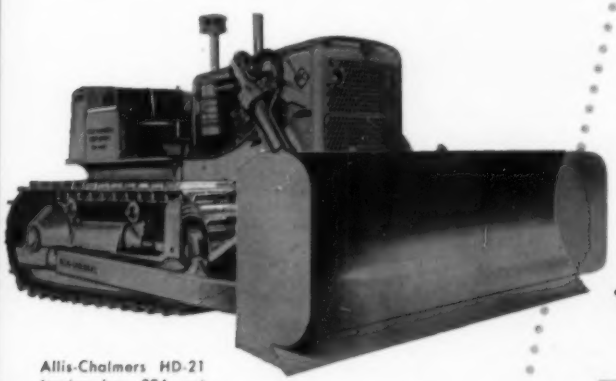
using Allis-Chalmers HD-21 Tractor with special coal blade

A special coal-handling blade now available for the Allis-Chalmers HD-21 fully uses the tremendous power and weight of this big tractor to move 15 tons of coal at a time.

HD-21 is coal-handling specialist— With its 204-hp diesel engine, the HD-21 has plenty of power for moving big loads. The hydraulic torque converter drive multiplies drawbar pull up to four and a half times, automatically accelerates to the highest traveling speed conditions permit. The torque converter permits climbing steeper grades, prevents killing the engine or digging in at soft spots, eliminates effort and time lost in shifting.

The compacting effect of a crawler tractor is well known. Through repeated trips over the coal pile, the 26-ton HD-21 and blade eliminate voids, prevent spontaneous combustion. The blade is shaped to move coal easily with a minimum of coal separation.

Dependability of the HD-21 is assured by Allis-Chalmers advanced design — Box-A Type Main Frame, one-piece steering clutch and final drive housing, straddle-mounted final drive gears, roller bearing truck wheels, through-hardened track rails — which also mean long life, less maintenance and faster repair when necessary.



Allis-Chalmers HD-21 tractor has 204 net engine hp, weighs 26 tons complete with cable or hydraulically controlled blade. Special coal blade has extra 56½-in. height and 15-ft length, plus boxed-in ends to carry 15 tons or more at a pass.

For additional information about the HD-21 tractor and coal blade — or about the other Allis-Chalmers tractors, tractor shovels, scrapers and motor scrapers — see your Allis-Chalmers construction machinery dealer or write direct to the company.

ALLIS-CHALMERS, CONSTRUCTION MACHINERY DIVISION
MILWAUKEE 1, WISCONSIN

ALLIS-CHALMERS

Now Under Construction...

18% MORE POWER

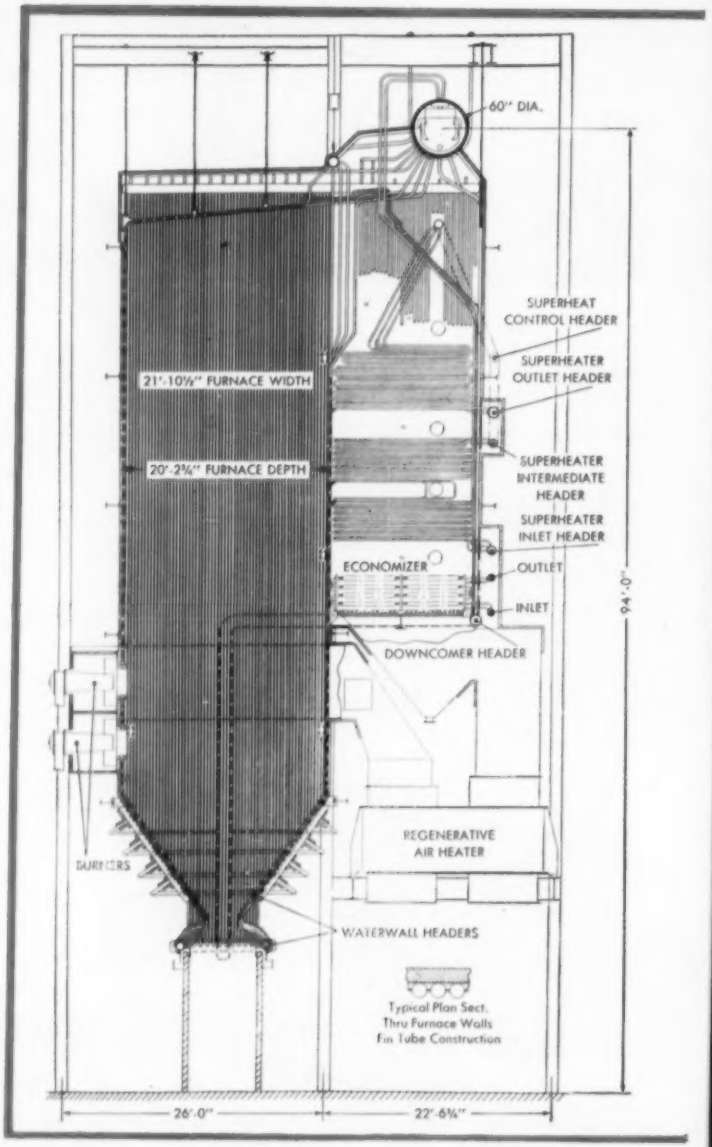
New 88,000-kw Yarmouth Station
will be served by

TWO FW STEAM GENERATORS

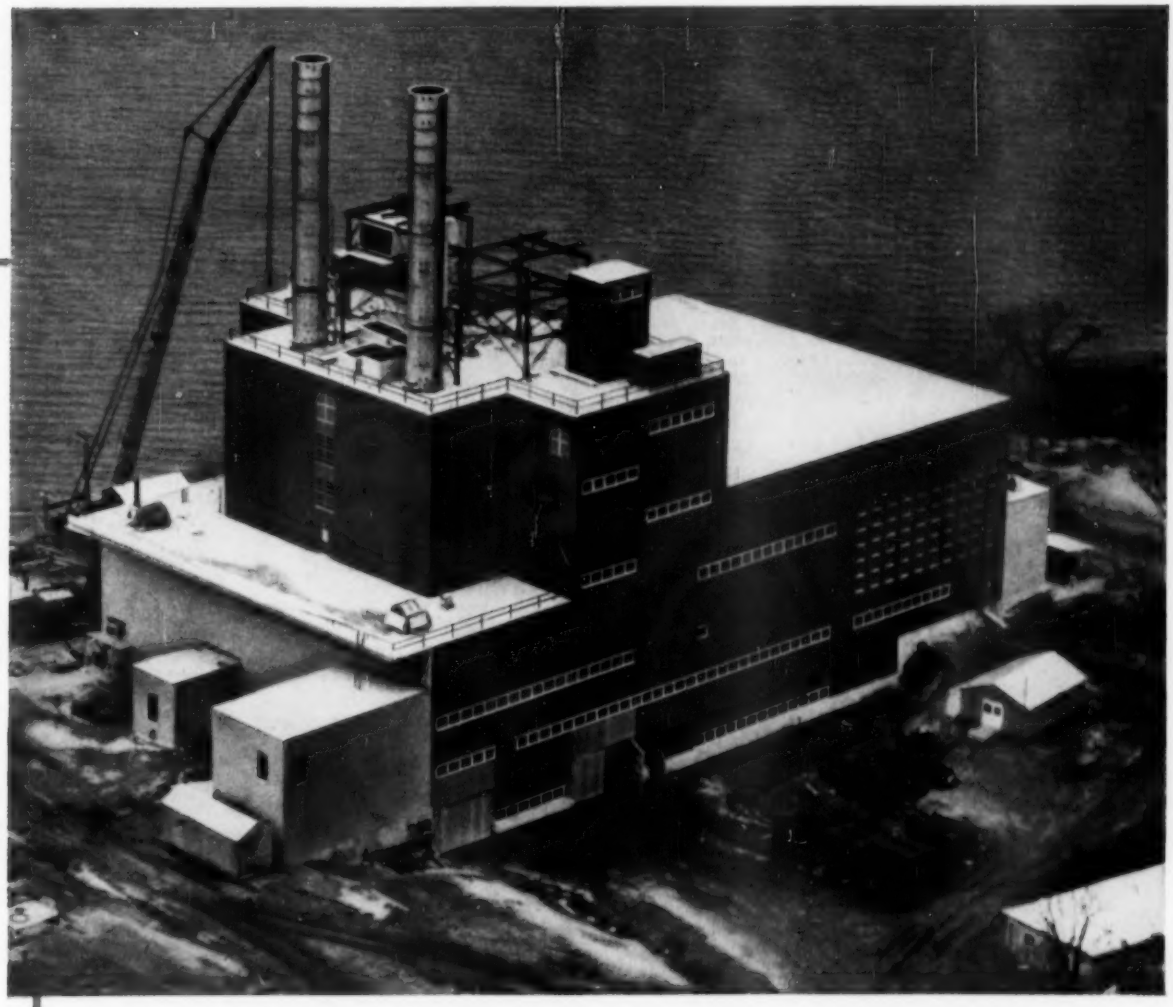
To meet Maine's growing demand for electric power, the Central Maine Power Company is building a new station at Yarmouth which increases total system capacity from 470,730 to 558,730 kw. This installation will consist of two identical units, each with a rated capacity of 44,000 and capability of 50,000 kilowatts.

Foster Wheeler is supplying the two steam generators for this important new station. Each will produce 490,000 pounds of steam per hour at 1575 psig design pressure, 950 F, and will deliver steam to the turbines at 1250 psig. These units are designed for either oil or coal firing.

With more than fifty years of experience in steam generation—and the finest modern manufacturing facilities in three large plants — Foster Wheeler welcomes the opportunity to quote on your requirements. *Foster Wheeler Corporation, 165 Broadway, New York 6, N. Y.*



for CENTRAL MAINE



An aerial view of the new Yarmouth Station of Central Maine Power Company. Unit No. 1 is scheduled to be in operation this year and Unit No. 2, in 1958. During the past decade, virtually every kind of Maine business has drastically increased its kilowatt-hour use of electric power. The Yarmouth Station will keep CMP well ahead of this growing demand — immediately increasing total system capacity by 18%.

FOSTER WHEELER

NEW YORK • LONDON • PARIS • ST. CATHARINES, ONT.

For more data circle 528 on Post Card

CONSTRUCTION NEWS

Anchorage, Alaska — The Chugach Electric Association, Inc, has announced that they have received permission from the FPC to construct a new hydroelectric generating plant where site has been selected on Cooper Creek on Alaska's Kenai Peninsula. It will be equipped for an initial capacity of 15,000 kw and is reported to cost $6,000,000, including power dam, switching stations, transmission lines, etc.

Glendale, Calif. — City Department of Light & Power is arranging a fund of $6,500,000 through bond issue for expansion and improvements in municipal electric plant. Work will include increased generating capacity, power substations and other work.

Los Angeles, Calif. — Southern California Edison Co, 601 W Fifth St, has arranged for the sale of stock issue in the amount of $30,000,000, proceeds to be used in connection with 1957 construction program, including expansion and improvement of company's generating equipment, transmission lines and other operational facilities. Company has filed an application for exemption from competitive bidding on the stock issue with the California Public Utilities Commission.

Riverside, Calif. — California Electric Power Co, 3771 W Eighth St, has arranged financing in the amount of $6,000,000, through sale of a bond issue, proceeds of which will be used in connection with 1957 construction program, including expansion and improvement of company's generating equipment, transmission lines, etc.

Denver, Col. — Public Service Co of Colorado, 900 15th St, has arranged for the sale of a bond issue in the amount of $30,000,000, proceeds to be used to retire short term bank loans and in connection with current construction program including expansion and improvement of company's generating equipment, transmission lines and other operational facilities. Company has filed a registration statement with the SEC for proposed bond issue.

Fort Lauderdale, Fla. — Board of Commissioners, State Institutions, Tallahassee, Fla., have awarded a contract to Bradford Builders, Inc, 1101 Lincoln Rd, Miami Beach, Fla., for construction of kitchen and dining hall buildings, security building, maintenance building and boiler plant addition and lift station at Southern Florida State Hospital, West Hallandale, Fort Lauderdale, Fla. Cost of entire project reported to be in excess of $1,029,599.

New Albany, Ind. — Public Service Company of Indiana Inc, 110 N Illinois St, Indianapolis, Ind., has announced plans for major expansion of company's generating facilities at local plant. Plans call for doubling capacity of company's 300,000-kw New Albany power plant and work on the installation of two new 150,000-kw generating units will get under way soon, for scheduled completion in 1960. Company plans to place first 300,000-kw unit in operation the latter part of this year. Installation of the two new units, transmission lines and substation facilities will cost an estimated $62,733,000 and will bring total cost of the project to $109,733,000.

Dubuque, Iowa — Interstate Power Co, 1000 Main St, has arranged financing in the amount of approximately $23,000,000, and has placed its proposed $20,000,000 first mortgage bonds and 680,000 shares of common stock in registration with the SEC. Proceeds from the twin financing will be used to provide funds for an estimated $17,700,000 purchase of certain properties from Kansas Power & Light Co, to repay bank loans and to pay in part for additions to company's operational facilities.

Boston, Mass. — New England Electric System, 441 Stuart St, has announced plans for the construction of property additions and additional generating and distributing facilities in the 1958–1960 period at a rate of approximately $40,000,000 annually. Work on the addition of a 140,000-kw steam-electric generating unit at Salem Harbor, Mass., is progressing on schedule and is expected to be placed in line by mid-1958 at a cost of $25,000,000. When completed, this will bring total capability of station to 300,000 kw. Company's long range program also includes developing tidewater sites for installation of large generating equipment. Company spent $39,000,000 for improvements in 1956.

Holyoke, Mass. — Holyoke Water Power Co has requested permission from the FPC for authority to issue a bond issue of $37,400,000, proceeds of which will be used to pay for the construction of a 125,000-kw steam-electric generating plant, now under construction near here. Company serves the central part of Massachusetts with electricity.

Kansas City, Mo. — Missouri Public Service Corp, Hout Bldg, Warrensburg, Mo., has authorized plans for the construction of a new steam-electric generating plant with an initial capacity of 88,000 kw on local site near here, selected for the purpose. Construction of the first unit will begin early in 1958 and will be completed by early 1960. Construction program is reported to cost in excess of $20,000,000.

Newark, N. J. — Public Service Electric & Gas Co, 80 Park Place, has filed an application with the New Jersey Public Utility Commission, covering the proposed sale of preferred stock issue in the amount of $25,000,000. Company plans to use proceeds from the sale for general corporate purposes, including payment in part of the cost of this year's new construction program, budgeted at more than $130,000,000.

Beacon, N. Y. — Texas Co, Chrysler Towers, New York, N. Y., has announced plans for the construction of a large fully equipped nuclear radiation laboratory, reported to be the largest in the world, at its research center located here. Construction will begin at once for completion in April of 1958. The 8,000-sq-ft laboratory will have one and three story sections to house three different radiation sources. These will be a 6,000,000-v linear accelerator, first of its kind in the petroleum industry; a 3,000,000-v Van de Graaff generator, and a 35,000-curie cobalt 60 source of gamma radiation. Cost of project while not announced is expected to be of multi-million dollar proportion.

Syracuse, N. Y. — Niagara Mohawk Power Corp, 300 Erie Blvd West, has announced plans for the construction of new transmission lines and switching station to help move electricity from the St. Lawrence River to about 500,000 of its customers. Company's transmission line will run 55 miles from a State Power Authority plant at Taylorville, N. Y., to its own 400,000-kw switching station at Deerfield. The power line will cost approximately $4,000,000 and the switching station about $5,000,000, and both are scheduled for completion by late 1958.

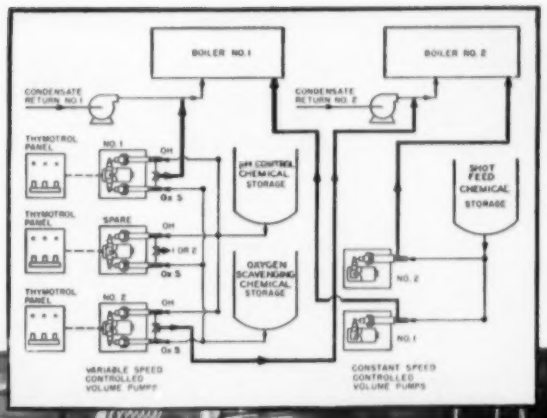
Raleigh, N. C. — The Carolinas Virginia Nuclear Power Associates has authorized an agreement with the Westinghouse Electric Corp for the development of a nuclear power plant to be completed by 1962. The Westinghouse Co, together with the Stone & Webster Engineering Corp, and the General Nuclear Engineering Corp, will assist the group in deciding what type of reactor to build, its location and in negotiation with the AEC for a development contract to cover the program. The reactor group includes such companies as Carolina Power & Light Co, Virginia Electric & Power Co, Duke Power Co, and South Carolina Electric and Gas Co.

Portland, Ore. — Pacific Power & Light Co, Public Service Bldg, has announced a construction program through the balance of this year to total an estimated $56,000,000. Company serving 300,000 utility customers in five Northwestern States, has construction program now under way which will add 250,000 kw of hydroelectric generating capacity and 100,000 kw of steam power to the system. To cover partial cost of the program, company has arranged financing in the amount of $30,000,000.

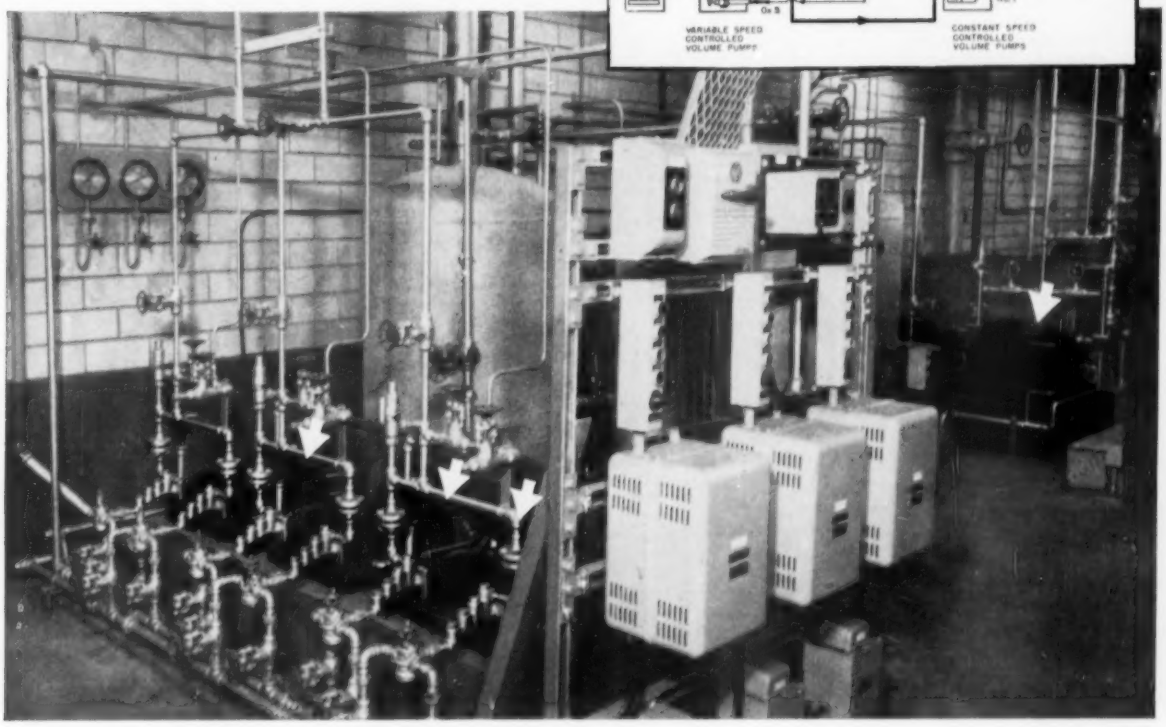
Columbia, S. C. — South Carolina Electric & Gas Co, 328 Main St, has announced plans for the construction of property additions in the 1957–1959 period, including an estimated $29,000,000 for 1957, to total approximately $75,000,000. A sizable portion of the 1957 budget will go toward the completion of a new 275,000-kw steam electric generator installation which will boost company's total capacity to more than 890,000 kw. Company has arranged financing through stock issue to cover part of this cost and plans a bond sale for additional funds later this year.

Richfield, Utah — Garkane Power Association, Inc has announced plans for the construction of a hydroelectric project on Boulder Creek in Garfield County, Utah. The installation will have an initial capacity of 2,800 kw and is estimated to cost approximately $1,600,000, including power dam, switching stations, transmission lines, and other work.

Tacoma, Wash. — Department of Water & Power has authorized a bond issue in the amount of $5,000,000, proceeds of which will be used in connection with expansion and improvement of city's electric generating plant and system and electric power and light transmission and distribution system. Work is currently under way and is scheduled for completion by late 1958.



Boiler water treatment installation of Controlled Volume Pumps at a major utility.



Save chemicals in boiler water treatment with Controlled Volume Pumps

Controlled Volume Pumps efficiently deliver the small quantities of treating chemicals required to protect boilers from scale, embrittlement, corrosion and pitting. They meter and pump chemicals in measured volumes directly into high pressure feedwater lines . . . within an accuracy of ± 1%.

The accuracy of Milton Roy Controlled Volume Pumps puts chemicals to work in the *exact* quantities required . . . keeps chemical consumption at a minimum.

Milton Roy designs and fabricates complete packaged systems for the treatment of boiler feedwater. Check with your water treatment specialist for the system best suited to your station.

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EQUIPMENT NEWS

Described on these pages are new and improved products. Use Reader Service Cards on pages 123–124 to ask for more information on them. Just circle the item numbers of all the products in which you are interested.

1—STEAM TRAP can be installed outdoors or indoors

Industrial thermostatic steam traps in the Quik-Flex line are designed to meet weather conditions encountered in outdoor industrial steam processing — as in tracer line, meter box and other applications — as well as many indoor uses. Manufacturer says these traps are freeze-proof. Construction features emphasized include an Anderloy alloy valve and seat with high corrosion and scoring resistance, a cap of forged steam bronze or cast semi-steel, heavy duty cast steam bronze or semi-steel body. The removable cap permits access to trap interior.

In operation, when the trap is first installed, the bellows is compressed against flange on the guide rod, and valve is wide open. When steam enters the trap it contacts the bellows causing it to expand quickly and close the valve. As condensate and/or air collects in the trap, the drop in temperature causes the bellows to contract, opening valve and permitting escape of condensate and/or air. These traps are suited for capacities to 31,000 lb of condensate per hour. Pipe sizes are ½ through 1¼ in. Bulletin 257 gives data. The V. D. Anderson Co.

2—WIRE, CABLE designed for wet or dry locations

Heat and moisture resistant, rubber insulated and fibrous covered wire and cable is announced as Type RHH 90 C — RHW 75 C. For general use in wet or dry locations, Type RHH-RHW is reported to carry UL listing for 600-v service in Sizes 14 through 6 AWG. The insulation is company's Nepcozone butyl developed for high voltage cable where its ozone and corona resistant properties are desired. This wire is expected to find application in industrial plants and boiler rooms where heat and moisture may be present and rubber insulation characteristics preferred. National Electric Products Corp.

3—PACKAGED CO_2 SYSTEMS for protection against fires

These packaged carbon dioxide fire extinguishing systems come in sizes from 10 to 300 lb of carbon dioxide. Also available are local and remote manually-operated actuating controls with the larger automatic systems. These packages contain all components needed to install an automatic system which will protect rooms of 140 to 6000 cu ft. One or more CO_2 cylinders, rate-of-temperature-rise fire detectors with connector tubing, automatic control and discharge heads with a manual actuating device, discharge nozzles, cylinder supporting frame and instructions are included. Pipe and fittings for each size system, and accessory items, such as remote control pull boxes, can be ordered separately. These systems are announced for industrial spaces containing normal flammable liquids and enable

smaller plants to provide inexpensive automatic fire protection for hazards previously safeguarded by portable equipment. Walter Kidde & Co., Inc.

4—METERING UNITS are both smaller and lighter

Formfit Metering Units, Type FMU, up to 42 per cent smaller and 62 per cent lighter, are announced. For metering, relaying and control applications, for indoor or outdoor service, the new oil-filled units combine current and potential elements into a single fabricated steel case with cover-mounted bushings. Both single- and three-phase units are available in standard voltage ratings from 25 through 69 kv with primary current ratings of 10/20 through 400/800 amp.

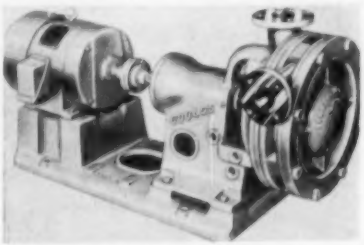
All ratings have series-parallel primaries to provide double current ratings. Current ratios can be readily selected by an oil-immersed switch at the top of each primary current bushing. The switch is an externally-operated, no-load device with an indicator, visible from a distance. Westinghouse Electric Corp.

5—SPEED REDUCER is versatile shaft-mounted unit

For many applications where complex multiple reduction belt or chain drives have been required, this shaft-mounted speed reducer is reported to offer flexibility of mounting arrangement, increased safety and lower maintenance expense. Ratio changes can be made in minutes simply by changing pulleys, it is pointed out, and a variety of pulley sizes makes the unit adaptable to a broad range of speeds. This speed reducer comes in most ratings from ¼ ro 40 hp at output speeds from 10 to 420 rpm. Company says it is easily mounted on driven machine, while a standard drive motor can be located in virtually any convenient position. Compact and light in weight, the speed reducer has a 360-deg mounting range around the driven shaft, and is adaptable to a variety of shaft diamters. It comes in single and double reduction ratings, in ratios of 5- and 15-to-1. General Electric Co.

6—CENTRIFUGAL PUMP for handling the corrosives

Specifically designed for corrosives, this glassed centrifugal pump, the Figure 3708, is the result of cooperative effort by Goulds Pumps, Inc. and The Pfaudler Co. To permit glassing the insides of the pump chamber and associated parts, a three-piece construction was developed, in which casing, suction piece and casing cover are separate glassed parts which



fit together to make a corrosion-resistant pumping unit.

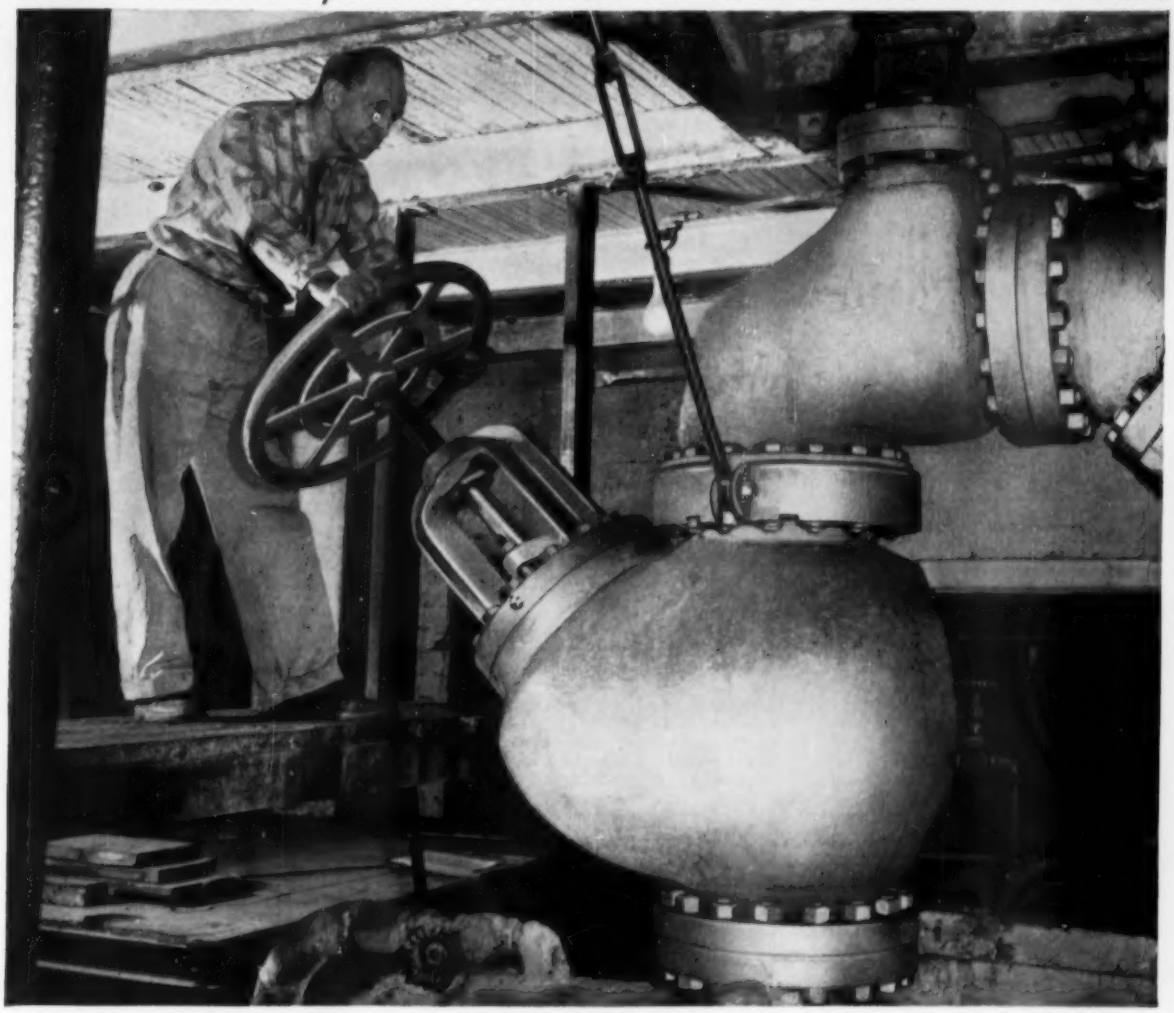
Inner surfaces of the iron pump are glassed, so that the pumped liquid doesn't come in contact with metal. Thus, it is noted, the full corrosion resistance of the Pfaudler glass to all organic acids (except hydrofluoric) and alkalis up to pH at 212 F are utilized. This means, according to manufacturers, that you can switch from one product to another without concern about the pump's corrosion resistance. This glassed metal pump is reported to offer some outstanding hydraulic advantages, including improved flow qualities. Glass eliminates adherence of product being pumped to the interior of the pump, it is pointed out. It also facilitates cleaning operations. Being inert, glass exerts no catalytic effect, and will not enter into side reactions. Structural strength is also attributed to the glassed metal.

Flexibility in installation is a major design advantage offered by this pump. Suction can be placed in either a top vertical position or 90 deg either side of vertical, and the discharge outlet can be placed in four different positions. Increased versatility also results from the use of either a mechanical seal or a stuffing box. The stuffing box is on the suction side of the impeller where it is subject only to the suction head or pressure under which the pump operates. The pump comes in four sizes and capacities up to 700 gpm, heads to 140 ft. Goulds Pumps, Inc.

7—CIRCUIT BREAKERS in ratings to 400 amp

Tri-Pac Circuit Breakers contain a modified AB breaker and a current limiting fuse with three tripping elements; time-delay thermal, instantaneous, magnetic, and current-limiting fusible. The new breaker is claimed to eliminate any pos-

Crane Valves Pay for Themselves in Trouble-Free Maintenance



Beginning another 50 years of cost-free valve service

This remarkable case history proves how the right valve can save money in repairs and maintenance—again and again.

This Crane 10-inch stop-check valve has been in use since 1906 at Seattle Cedar Lumber Mfg. Co., Seattle, Wash. Operating at 360° F. and 150 psi., the valve is closed every third or fourth night when one of 3 boilers is shut down. The valve is also closed every 3 weeks when the boiler is down for inspection and cleaning. About a year ago, this Crane No. 28E Ferrosteel valve was opened for inspection, cleaned up, and put back into service. Repair parts needed? None.

In short, all 50 years have done to this Crane valve is emphasize how rugged and dependable it has proved, and how important it is to use quality valves on every service. For complete information on any valve problem, contact your Crane Representative.

YOU'LL FIND GOOD tips on valves in "Valve Performance Facts"—32 case histories throughout industry. Ask your Crane Man for a copy or write to address below.

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sibility of single-phasing on faults, and can be quickly reset after breaking on overload or usual fault current. Tripping cause, whether overload, usual fault or extreme fault, is indicated on resetting of breaker. Company notes that fuse testing is eliminated by the plungers in the special fuses that tell which phase or phases are in trouble. The breakers now come in three frames in NEMA standard ratings of 100, 225 and 400 amp, two or three poles. Higher ratings are planned. Interrupting capacity at 250 v d-c and 600 v a-c is 100,000-rms amp. Westinghouse Electric Corp.

8—PULLING ELBOW for easier wiring around corners

According to company, this pulling elbow makes wiring around corners a snap. Simply slip wires straight through conduit and out one hub. Then make a big loop of wires and again push through hub and conduit. Pull wires taut from other end of system — cover attaches

quickly with big screws, opens easily. Pulling elbow is made of cadmium-plated iron. The fitting has smooth surfaces to provide better cover and gasket seal — hubs have tapered pipe threads and are positioned 90 deg from center. Smooth inside surfaces are designed to eliminate chances of skinning insulation on wire when pulling it through electrical system. Elbows come complete with cadmium plated steel covers, Neoprene gaskets and large cover screws. Cover is domed for greater rigidity and more wire area inside elbow. Ideal-Simplet Fittings, Inc.

9—EXPANSION JOINTS offer high pressure stability

Improved corrugated self equalizing expansion joints for power and process piping systems are announced as featuring longer service as well as greater high pressure stability. They are shorter and lighter in weight than company's previous models. In protecting piping and other equipment against damage from temperature change, these expansion joints employ equalizing rings to distribute pipe line expansion equally to all of the corrugations. According to manufacturer, this prevents over-compression of the corrugations beyond design limit. The equalizing rings also support the roots of the corrugation against internal pressure, permitting use of thinner metal in the bellows, and giving the expansion joints lower flexing stresses and thus longer operating life.

Made from stainless steel, the new joints come in sizes from 3 to 72 in. diameter in single or double units, for pressures to 300 psig, and temperatures to 1600 F. Copper self-equalizing expansion joints, for copper and brass piping come in sizes to 24-in. diam, designed for maximum operating conditions of 125 psig, and 406 F. Zallea Brothers.

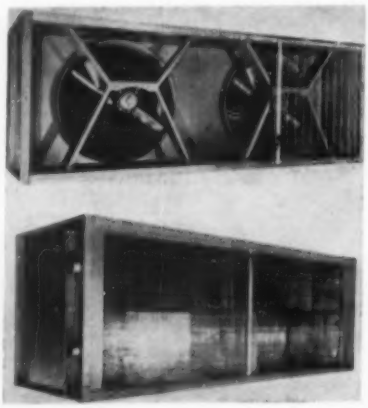
10—D-C MOTORS, GENERATORS feature improved insulation

Now in production, the Life-Line H series of d-c industrial motors and generators, is reported to achieve a new measure of performance and dependability from standard d-c machines. They are designed to be equally effective as basic prime movers or as elements of complex automatic production systems. The new units have dripproof enclosures as standard and bear NEMA Class B ratings; they span motor ratings from 1 to 150 hp and generator ratings from ¾ to 100 kw.

Among features announced as available for the first time in standard motors and generators are a high-temperature silicone insulation system in machines rated to operate within Class B temperatures; a controlled ventilation system that draws air from the drive end, distributes flow throughout the machine, and expels it at the commutator end; and a housing construction which lets the dripproof machines serve many applications which ordinarily require splashproof equipment. Further, as the result of a marked decrease in armature inertia and improved commutating ability, Life-Line H Motors are claimed capable of the fastest dynamic response now available with standard industrial machines. Manufacturer says armature inertia of the entire line has been decreased by as much as 55 per cent in some ratings—and commutating ability has been increased by 35 per cent. Westinghouse Electric Corp.

11—HEAT EXCHANGER of high heat removal capacity

This newly designed Aero Heat Exchanger is announced for installations requiring the cooling of fluids, or condensing vapors, in chemical process, industrial or power applications. The unit consists of an arrangement of heavily finned tubes in a casing through which air is drawn by two propeller-type fans. Heat transfer is from the fluid through the tube walls and extended surfaces to air that is exhausted into the atmosphere. Manufacturer explains that the design provides high heat removal capacity per unit by means that assure movement of air in large volumes. There is provision for free drainage of condensate liquids when units are used for condensing.



The units are built in four standard sizes — the largest is 63 in. high, 126 in. long. Arrangements provide for stacking vertically or horizontally in multiple unit installations. Standard construction is hot-galvanized steel surface and casings. Niagara Blower Co.

12—SAFETY STRAPS are made of spun nylon webbing

The solid woven spun nylon material used in this line of safety straps is double impregnated and reported to have excellent dielectric qualities. It is designed with a red center which acts as an automatic signal indicating when "pole wear" calls for strap replacement. Tests — based on a single tongue buckle — are reported to show that on a straight pull, the buckle hole yields at about 1550 lb, and when tested as used on a pole, at 3450 lb. Cross section breaking strength is claimed approximately 5500 lb. Miller Equipment Co., Inc.

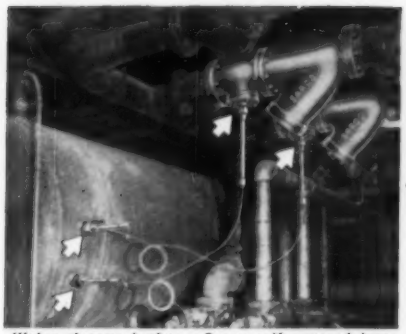
13—CAR SHAKER gets the stubborn stuff "all shook up"

Designed to expedite unloading of materials from hopper bottom, open top, railroad cars, this car shaker combines impact features found in shakers which operate on top edges of car only, with

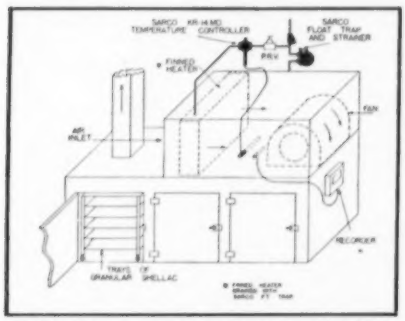
vibration features found in those which hang on car side and are clamped to under-frame of car. It is said to be particularly effective in loosening stubborn or frozen materials and starting a rapid flow from hopper openings. Shaker action is produced by rotating an unbalanced shaft at 1,800 rpm. The shaft is fitted in two heavy duty self-aligning bearings carried in bearing housings which fit snugly in two heavy side plates. The eccentric action of rotating shaft is carried directly to car without going through any welded connections. Shaft is driven by a 10-hp totally-enclosed motor on a spring-supported base. Eastern Constructors, Inc.

14—PART WINDING STARTER for full motor acceleration

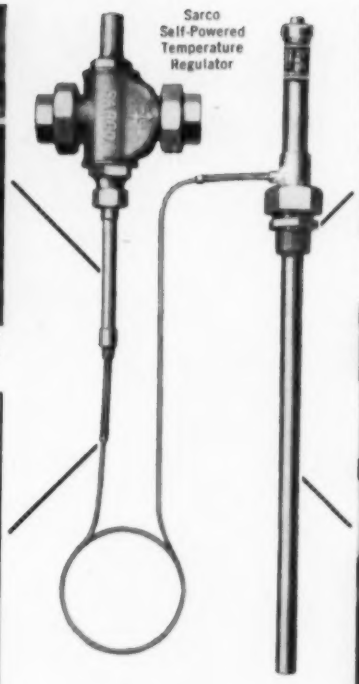
This method of two-step increment starting for induction motors provides reduced light flicker and quieter motor operation during acceleration, it is announced. Major application is expected to be in large commercial buildings and other locations where power companies require large induction motors be



Water storage tanks — Sarco self-powered temperature controls on service water storage tanks from twin heaters.

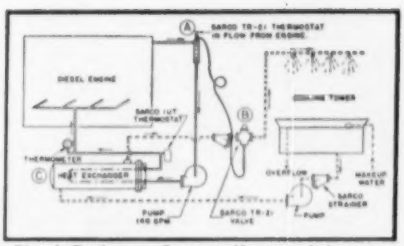


Shellac dryer — even temperature maintained; moisture uniformity of granular shellac accurately controlled — by Sarco self-powered temperature control.

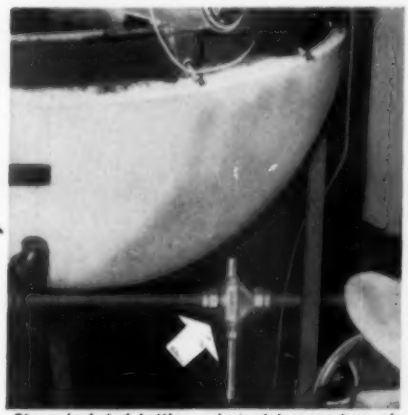


Sarco Self-Powered Temperature Regulator

FOR YOUR INDUSTRY
Chemical Processing • Metalworking
Food • Textile • Paper
Oil Refining • Others



Diesel Engine — Sarco self-powered temperature controller used on diesel engine cooling system. Also ideal for compressors.



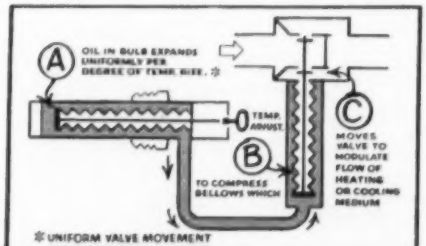
Steam-jacketed kettle — desired temperature of kettle content is automatically maintained by Sarco self-powered temperature control. Steam waste, uncertainty of manual control eliminated.

How to get Automatic Temp. Control that's simple, dependable, inexpensive

HERE'S the way to get rid of uncertain, time-wasting manual temperature control . . . *throughout* your plant. And without investing in complicated, costly temperature control equipment.

These SELF-POWERED Sarco controls are inexpensive, simple, dependable, accurate. They can be used for 85% of your jobs. ½" size costs only about $100!

Thousands of these Sarco controls are giving dependable, accurate service for firms such as Colgate-Palmolive Co., Sinclair Refining Co., Swift and Co.


A
OIL IN BULB EXPANDS UNIFORMLY PER DEGREE OF TEMP. RISE. *
TEMP. ADJUST.
B
TO COMPRESS BELLOWS WHICH
C
MOVES VALVE TO MODULATE FLOW OF HEATING OR COOLING MEDIUM
* UNIFORM VALVE MOVEMENT PER DEGREE OF TEMP. CHANGE

AS SIMPLE AS ABC . . . that's Sarco Self-Powered Temperature Control. A thermostat with capillary tubing and a valve . . . that's all there is to it!

SARCO SELF-POWERED TEMPERATURE CONTROLLERS
—need no power source

1. Self-Powered — no compressed air or electricity needed.
2. Easy to install — by any pipe-fitter.
3. Self-contained — no exposed mechanism. Packless valve.
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started with reduced kva inrush. Typical uses are air conditioning and refrigeration compressors, fans, pumps, blowers. The new system, called a two-thirds part-winding starter, will accelerate most loads to full speed on the part winding, it is explained, and this eliminates the second increment of current inrush characteristic of conventional part winding starting.

Company says this starter, the CR-7050, is easily connected for conventional one-half part-winding starting as well as the two-thirds method. Simple reconnection of leads of a standard 208-220/440-v motor to the new control is all that's required, according to company. The starter comes in ratings to 400-hp, 600 v. Its four-two pole arrangement is claimed to make possible one of the most economical of reduced-current starter-motor combinations. It consists of two contactors and a pneumatic time-delay contact. Enclosures are available in NEMA types 1 (general purpose), water-tight, explosion-proof and industrial service. General Electric Co.

15—LIQUID DETERGENT for steam cleaning operations

LSD is announced as a liquid detergent for use in solution lifting steam guns and self generating steam cleaning equipment. Developed to simplify preparation of steam cleaning solution and reduce clogging of coils in self-generating equipment, it will handle a variety of steam cleaning operations from light to medium-heavy duty. LSD is said to provide effective soil removal at concentrations of 1 to 2 oz to each gallon of water as delivered by the gun. Used as recommended it is claimed to be safe on steel, brass and magnesium, to have no effect on painted surfaces. Its solutions have a pH of 12 in the operating range. Oakite Products, Inc.

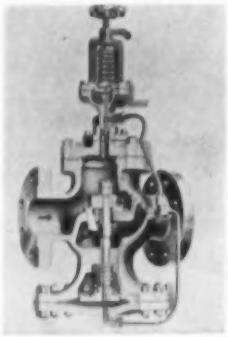
16—AIR PREHEATER cuts down fuel costs and smoke

Fuel savings up to 25 per cent and marked reduction in smoke and soot are announced for the Boston Air Preheater, recently introduced in this country following several years of use in Europe. This low cost unit, usually installed in the fire door of the boiler, supplies preheated secondary air over the fire bed or burners for maximum combustion of fuel. It consists of two basic sections: an adjustable air intake valve extending outside of the fire door; and a preheating chamber made from a heat-absorbing alloy mounted on the inside of the door. Air drawn through the intake by normal boiler updraft, circulates through a labyrinth of hot surfaces inside the preheating chamber, and is delivered over the fire bed or burners at over 400 F. The preheating chamber is heated by radiation that would normally be lost, company notes, so it consumes none of the fuel energy usable for operating the boiler.

The preheater is designed for use with low-or-high-pressure, oil-, coal-, or coke-fired boilers of the induced-draft, forced-draft or steam-blast type. It is stressed that this unit introduces secondary air at temperatures high enough to promote maximum combustion of unburned carbon monoxide and heavier hydrocarbon fractions that linger at the outer edges of the flame and normally settle out as soot or smoke. Manufacturer of the Boston Air Preheater says it can usually be installed in one day. The Preheater Corp. of America.

17—MARINE REGULATOR for use where vibration is factor

This regulator with integral pilot, while designed especially for marine services, is suggested for other applications in which vibration is a factor. To achieve the stability of pilot mounting required



by severe service, the pilot body is securely attached to the top flange of the regulator. Disassembly for inspection or repair of the pilot is easily accomplished, company says, by removing four bolts. The pilot is external to the main valve, with external control connections, which makes trouble-shooting easy. Pilot replacement for routine maintenance is reported quick and easy, and the same pilot fits all sizes of regulators. Spence Engineering Co., Inc.

18—AIR COMPRESSOR takes up less floor space

The Model WBN is a 200-hp, two-stage packaged unit which occupies only 34 sq ft of floor space. In many instances, this compressor is sufficient to permit retirement of two smaller compressors, company says, with corresponding saving in space. The WBN needs no special base, company notes, you simply bolt it down and hook it up to its source of power. Once installed, it is designed to operate on long, steady runs with little attention. The WBN is available with a tube-type intercooler or equipped with a self-contained radiator-intercooler. Gardner-Denver Co.

19—DRIP TRAP features stainless steel water valve

The Series 27 Float and Thermostatic Traps are made in five sizes with ¾, 1, 1¼, 1½ and 2 in. tappings. All sizes feature a stainless steel water valve and seat in which the valve operating parts are also 18-8 stainless steel stampings. Increased full flooded water capacity is obtained with quick and positive action provided by a double fulcrum arrangement. The thermostatic bypass is provided with a rugged, small diameter Sylphon bellows for automatic air venting. In all sizes the complete interior mechanism is attached to the cover and is removable from trap body without disturbing pipe connections. Bodies and covers are of semi-steel iron castings. Warren Webster & Co.

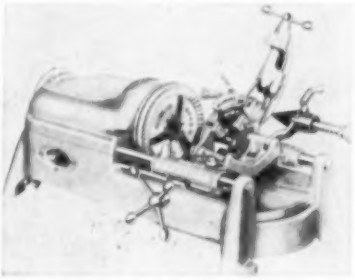
20—HEAT EXCHANGERS are available as required

This standard line of single- and double-pass carbon shell heat exchangers is introduced to enable solution of many heat exchanger problems without special or complicated designs but meeting ASME and TEMA code requirements. The "off-the-shelf" units are available from prestocked stainless steel heat exchangers in a variety of sizes from 56 to 316 sq ft within two weeks. Other sizes up to 20-in. shell diameter are assembled from a stock of "flexible standards" including tubing, bonnets, shells, baffles, nozzles on four-to-six weeks delivery.

Power engineers can specify design features previously considered as custom at standard costs, it is pointed out. Many combinations of diameter and length are available for any given heat transfer service, and the number of passes can be varied. Flange nozzles or couplings can be installed in any position required, and shell side baffles at any desired spacing. Standard shell diameters range from 4½ to 20 in. These units are designed for 75 psi tube pressure and 150 psi shell side pressure up to 300 F. Slight modifications are required for higher pressures. The Pfaudler Co.

21—THREADING MACHINE has new universal die head

Ridgid 535 Pipe and Bolt Threading Machine features a new universal die head, it is announced, a quick-opening type with two sets of dies which threads ½ to 2 in. pipe or conduit. One set of

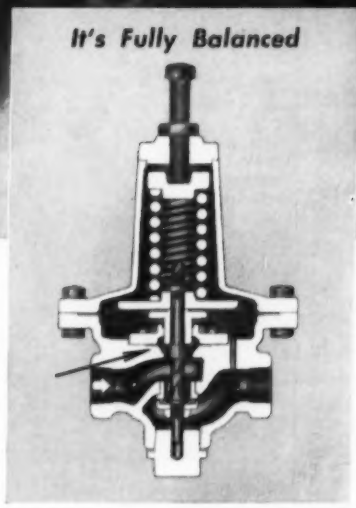


dies threads ½ to ¾ in.; the second set threads 1, 1¼, 1½ and 2 in. Priced at about $460, the complete 535 package also includes a roll-type cut-off with self-centering, full-floating cutter wheel and a five-flute cone reamer with ⅛ to 2 in. capacity. Operating independently, all tools swing up out of way when not in use. The 535 also has a concealed oil system. The Ridge Tool Co.

22—REMOTE CONTROL UNIT for the stand-by electric plants

This gasoline engine remote control unit, the Bulletin 216, is designed primarily for adapting push button started

Here is the new LESLIE "HI-FLO" Water Reducing Valve with 50% more capacity



Unique construction of "Hi-Flo" Reducing Valve. Note the small lower diaphragm that provides fully balanced, floating action.

HERE IS THE ALL NEW Leslie Reducing Valve with *capacity-regulation* features that have never been offered before. Here is a regulator with 50 - 100% greater capacity by actual test.*

Here's the unbeatable combination of design features:

"HI-FLO" — Large bowl construction; long stroke diaphragm gives full flow of water and other non-corrosive liquids.

FULLY BALANCED — The main valve, fully balanced by lower diaphragm, virtually floats to provide smooth, friction-free, throttling action.

DROP-TIGHT SHUTOFF — Resilient seating disc provides tight closure under all conditions.

TROUBLE-FREE DESIGN — Chatter and hammer eliminated; no piston cups or seals to clog or change. Corrosion resistant trim with renewable interchangeable fit.

Ask your Leslie Engineer to show you how the exclusive Leslie "Hi-Flo" valve can be used to your advantage in water reducing stations, fuel oil pressure control, process lines, etc. He's in your classified directory under "Valves" or "Regulators".

Write today for Bulletin 553 for graphic performance comparison and complete capacity data.

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electric plants to stand-by use. Some electric plant manufacturers utilize a two-button system of control for their remote control type plants, it is pointed out, and when this type of plant is used for stand-by service with a transfer switch, additional controls must be furnished in order that automatic starting and stopping will be controlled from contacts on the transfer switch.

Bulletin 216 Controls adapt this type of plant to such stand-by automatic operation. To do this, relays are necessary to provide cranking disconnect upon engine firing and overcranking disconnect and lockout if the engine fails to fire. The adapter unit not only contains cranking disconnect relay and overcranking disconnect unit, but also a four-position selector switch (manual, stop, automatic and test). The transfer switch with which it is used must be equipped with one contact which opens when the normal source fails, and another which closes when the normal source fails. Automatic Switch Co.

Reader Service Cards on pages 123–124 make it easy to get further information on any of these products. Just circle the item numbers of the products you want to know more about.

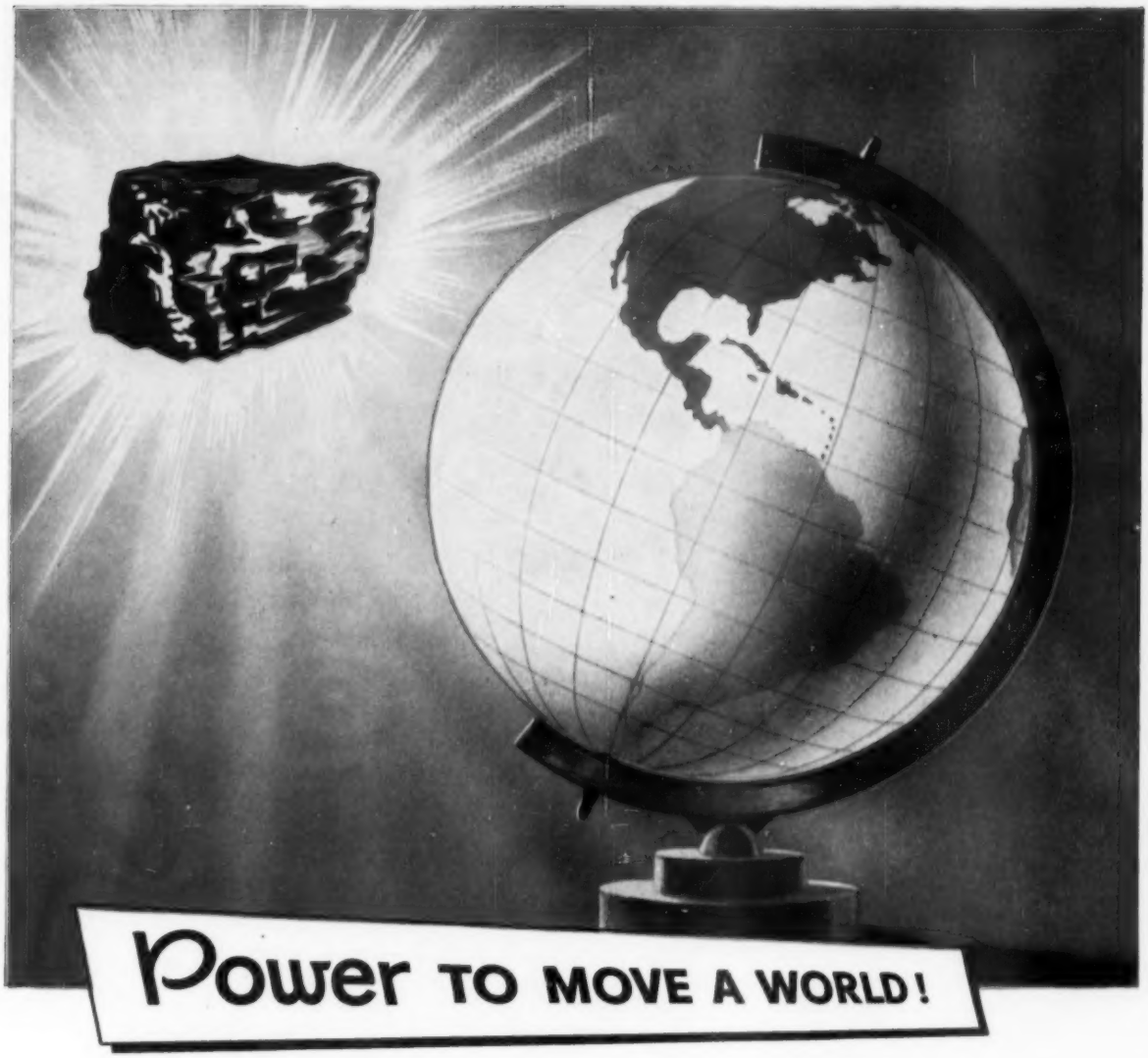
23—COLOR COAT covers the black bituminous coatings

Color Coat 261 is claimed to stick to and cover black bituminous coatings, old or new, as well as concrete, brick, cinder block, porous roofing tile, asbestos shingles, stucco and properly primed

wood and metal. Drying time is given as approximately 30 min. A modified acrylic resin dispersion combined with chemically inert pigments, Color Coat 261 leaves a tough pigmented plastic film that flexes with expansion and contraction of base material, says manufacturer, and it is especially suitable for color keying service lines. It is also reported to show resistance to weather, sunlight, gases, corrosive fumes, cleaning compounds and many solvents. Available in eight standard colors, Color Coat 261 is declared safe to store and apply. It goes on with conventional spray equipment, brush or roller. Insul-Mastic Corp. of America.

24—INDICATING LIGHT tests for burned out lamp bulbs

This push-to-test indicating light unit is designed for quick testing for burned out lamp bulbs on control panels and push-



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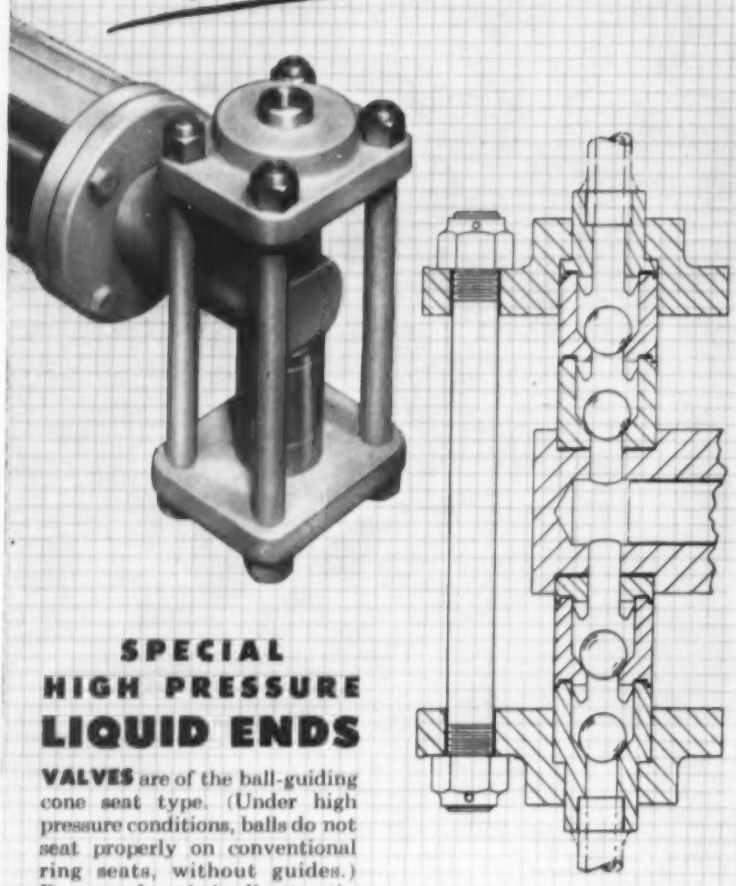
advanced design in high pressure pumps



SPECIAL HIGH PRESSURE LIQUID ENDS

VALVES are of the ball-guiding cone seat type. (Under high pressure conditions, balls do not seat properly on conventional ring seats, without guides.) Pressure drop is in direct ratio to ball rise. Valves are machined from solid stainless steel bar. Balls are hardened and ground stainless steel. They may be spring-loaded for down-stream pumping and viscous materials (up to 30,000 SSU).

HEADS are forgings or castings, depending upon size.

PISTONS are highly polished stainless steel or ceramic, ground and polished, as required.

PACKING is contained in the gland, *not divided*. Gland take-up is a screwed nut rather than a lantern flange, insuring even pressure on packing—*no cocking*.

Write for Bulletin HP-1254.

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13500 Philmont Avenue, Philadelphia 16, Pa.

PHILADELPHIA SERIES HP HIGH PRESSURE PUMPS

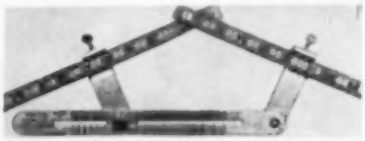
For more data circle 535 on Post Card

button stations. Through use of a continuously energized testing circuit an immediate indication of a faulty bulb is given by pressing the unit's color cap, company announces — you don't have to remove the indicating light cap or the bulb. The device's basic unit is interchangeable with company's new illuminated oiltight push button.

Easily fitted in the same hole and mounting space as existing oiltight units, the new device can be panel- or back-mounted. The cap is faceted for wide-angle visibility and comes in six colors. The device uses a 6-v bulb built to resist vibration. General Electric Co.

25—RULE ATTACHMENT is inexpensive and handy tool

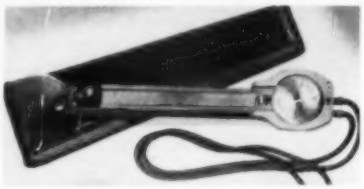
Offering a simplified approach to bending problems, the Protracto-rule fits onto a 6-ft rule and extends the latter's



usefulness in a variety of ways. It serves as a working guide while forming bends in conduit, bus bars and pipe. It makes a useful protector and tri-square, providing 6 ft of measuring scale in a pocket-size package. Also, it can double as a template for layout work. An instruction sheet, furnished with the unit, gives directions for use. C & B Engineering & Fabricating Corp.

26—RANGE FINDER for measuring 8- to 100-ft distances

Small enough to carry in a pocket, this range finder has a 6-in. base and is designed for quickly measuring distances from 8 ft to 100 ft, even distances to inaccessible objects and places. Operation of the instrument is based on coinci-



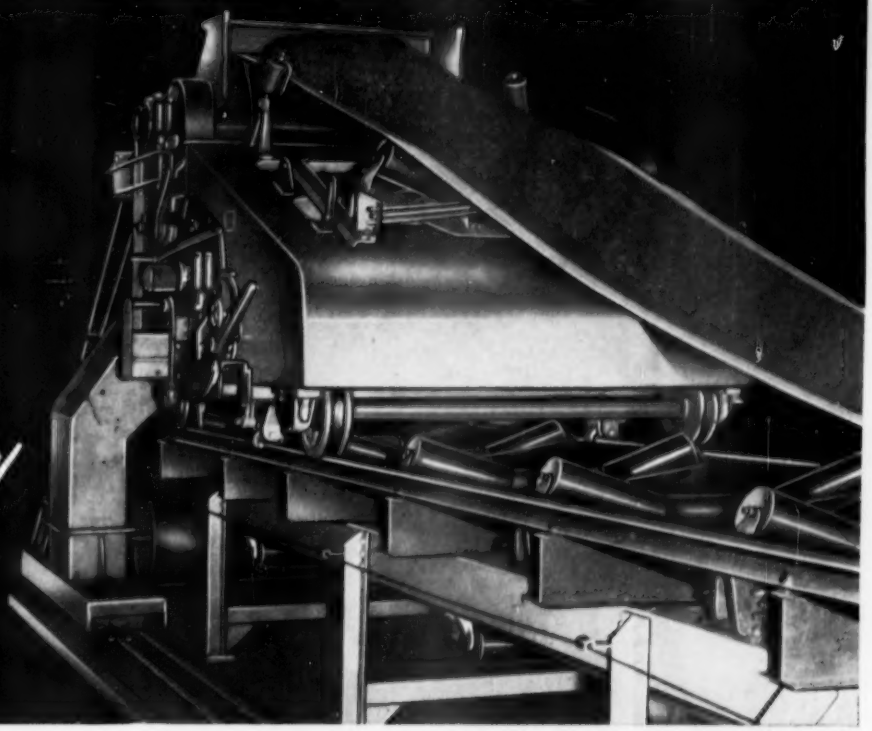
dence of two images: one seen in its natural color and the other seen in a strongly contrasted gold color. Upon sighting through the eyepiece both images will be seen. When you turn the knob, the white image moves either toward or away from the gold image. When the two images coincide perfectly, the range finder is in perfect alignment; then you can read the distance to the object on the dial. Accuracy is given as within 2 per cent. The range finder is supplied in leather case; it costs around $33.00. Edmund Scientific Co.

27—AIR COMPRESSOR features safety, compactness

The Channel-Flo is a two-stage, 200-psig rated motor compressor presently available in 1½ and 2-hp sizes. The packaged unit includes motor compressor, cushioned rubber mounting on an ASME vertical tank, interconnecting

STEPHENS ADAMSON

coal conveying systems for *TODAY* and *TOMORROW*



S-A tripper and exclusive zipper bunker seal. Seal zips open and closed. Eliminates dusting.

The power plant built for present needs is expected to serve the next generation too. The men responsible for the purchase of vital coal conveyor systems for power generation may expect to buy only one such system in their lifetime.

Such a system must function flawlessly for years to come. It must be economical in installation and delivery costs and must be sparing of man power.

To create such a power servant demands the finest engineering, the best construction, and above all, experience. These are S-A qualities and they have been earned in long service to the power field. This is why, more and more in coal handling systems, the big name is S-A—the name with a 50 year reputation for building equipment that will serve the power needs of our generation—and the next.

Knittel crushers built by S-A and used to reduce run-of-mine coal to stoker size. They are compactly constructed, requiring little headroom and are extremely dependable. S-A crushers are available in many sizes and variations to meet specific requirements.

S-A REDLER conveyors and elevators, patented products, ideally move crushed coal over any plane, completely enclosed, eliminating all dusting problems. Specially designed flights move coal forward in a solid column. Discharge is possible at single or multiple stations.

S-A manufactures a wide range of material handling products in three complete plants in U. S. and Canada.

Belt Conveyors
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Illustrated are a few of the many types and sizes of Rotojet Tube Cleaners driven by air, steam or water. We analyze each application before recommending equipment that best meets the requirement.

ELLIOTT COMPANY - ROTO DIVISION

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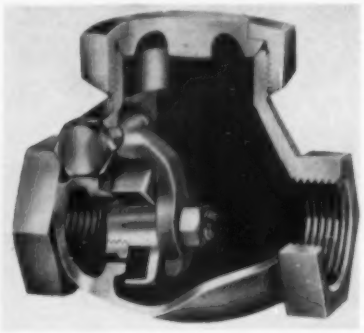
piping and fittings and automatic start-and-stop control. Manufacturer claims important safety and space-saving features in this unit. The compressor is flange-mounted directly on the driving motor, it is noted, and thus requires less floor space than tank-mounted, belt-driven units of comparable size. It can also be mounted on a shelf, side wall or overhead bracket with air receiver located in an out-of-the-way space.

The unit derives its name from company's Channel Valves used in both low and high pressure cylinders. Introduction of this valve in the small compressor sizes is said to mean less valve maintenance and longer compressor life. The Channel-Flo features balanced-opposed piston construction. Form 1547 gives details. Ingersoll-Rand Co.

28—SWING CHECK VALVE has renewable composition disk

This bronze swing check valve, the Fig. 0630, features a renewable composition disk. Manufacturer notes that swing check valves are generally recommended for service on liquid lines where full



unobstructed flow or minimum resistance to flow is desired. The renewable composition disks serve to protect the valve seat from damage due to pulsating pressures affording considerable savings in replacement costs to users. The disks can be replaced without removing the valve body from the line. They are regularly furnished in a medium-hard type for liquid service and steam disks are also available. The valves, rated at 150 lb steam working pressure, 300 lb cold water, oil or gas, come in sizes from ½ through 2 in. The Fairbanks Co.

29—DUCT FAN, belt driven, for severe operating conditions

Type BD Duct Fan is designed to operate under corrosive atmospheres and extreme temperature ranges. The belt-driven unit incorporates a blade design said to produce a higher pressure characteristic while reducing noise to a minimum. The fan is reported suitable for use in surroundings such as acid fumes, explosive vapors, dust and gases, and capable of handling temperatures to 150 F. (Special models are available for temperatures to 650 F.) Bearings of this fan are mounted inside the air-insulated belt housing, enabling the motor, which is located out of the air stream, to be positioned horizontally or vertically. With two-, four- six- or eight-bladed steel or aluminum wheels, as specified, the fan comes in sizes from 12 to 72 in. Chicago Blower Corp.

more Equipment News on page 134

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STEAM GENERATORS for economical outdoor operation have been featured by Vogt for many years and serve leading chemical plants and petroleum refineries. Requiring no building for housing, such installations, as pictured here, produce more steam per dollar of investment and are a definite aid to lower production costs.

Get Vogt's recommendations for steam generators to meet your needs for power, processing, or heating, without obligation. Package type and custom built units are available in a wide range of types, capacities, and pressures to meet operating requirements.

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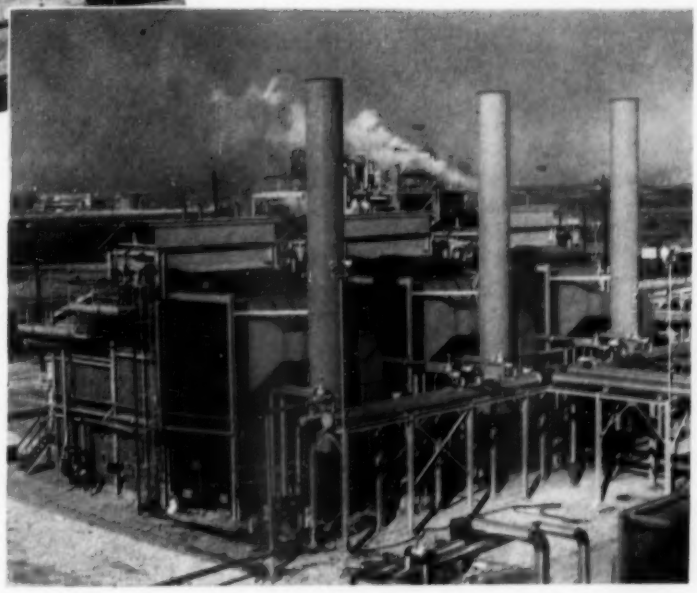
Three 85,000 #/hr. steam generators in a Texas refinery.



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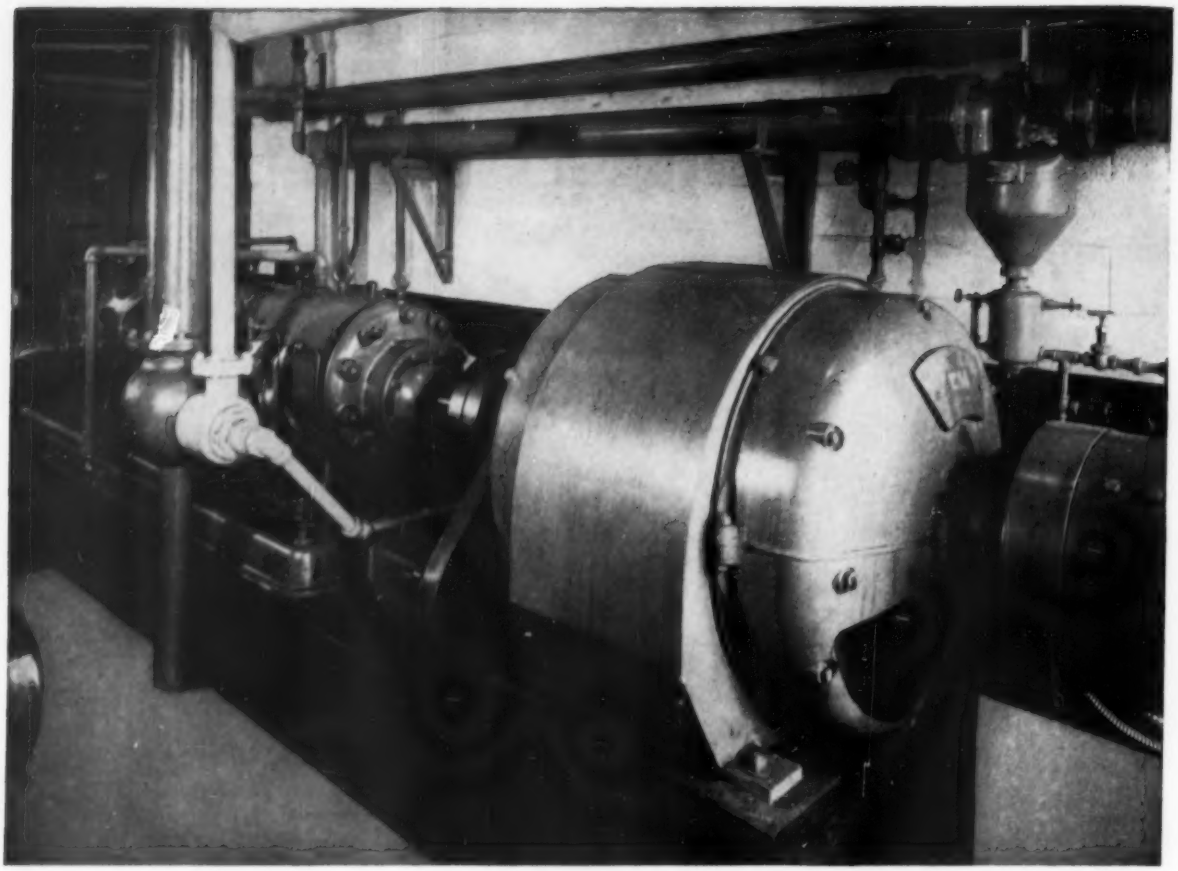

THEY'VE ORDERED FULLER ROTARIES AGAIN AND AGAIN . . .

The proof is the record. Reading Tube Corporation bought its first Fuller Two-Stage Rotary Compressor in 1944—a C50-50H. To meet expanding pneumatic power requirements for increased production, they added a C100-100H Rotary in 1946. Again, the only and obvious choice was Fuller. In 1953, Reading Tube installed its third Fuller Rotary—a C175-175H, and reports continued satisfactory and economical operation, with a bare minimum of maintenance on all three.

Reading Tube Corp. uses Fuller compressors exclusively for such variety of needs as supplying air power in their casting shop, mill, draw benches, in testing and packing, as well as for hand accessories such as grinding, polishing, drilling, etc.

Check these advantages when your plant needs reliable air power . . . . they've made Fuller the choice, time and time again.

. . . full capacity for life of the machine

. . . smooth air flow

. . . sustained performance for top capacities up to 3300 c.f.m. and pressures to 125 pounds

. . . compactness and ease of installation, requires minimum space and light foundation

. . . vibrationless due to absence of reciprocating parts.

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new Misericordia Hospital will

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BY INSTALLING

FW PACKAGED STEAM GENERATORS

Lowering one of the 43,500 lb FW Packaged Steam Generators into the basement of the Misericordia Hospital.

SCHEDULED for completion early in 1958, the $8,000,000, 210-bed Misericordia Hospital, Bronx, N.Y., will be fully equipped with the finest and most modern facilities obtainable.

All steam requirements will be supplied by three fully-automatic Foster Wheeler Packaged Steam Generators, each rated 17,500 lb/hr at an operating pressure of 125 psi. Each two-pass steam generator contains 1857 sq ft of heating surface and generous furnace volume. Staggered tube arrangement permits a high heat transfer rate and low exit gas temperatures. These FW Packaged units also offer the following cost-saving advantages:

* **SAVE TIME — because they were completely shop fabricated and delivered by truck direct to the building site, all ready to set in place and connect to power, fuel and steam lines.**

* **SAVE SPACE — because of exceptionally low ratio of unit size to quantity of steam produced. Measuring only 12'1½" high, 10'11½" wide and 16½' long, these 17,500 lb/hr units are installed on small, low-cost foundations.**

* **SAVE MAINTENANCE — because they are specially designed for easy servicing and inspection. Consisting almost entirely of water heating and steam producing pressure parts, there is a minimum of refractory and tile maintenance.**

FW Packaged Steam Generators are available in capacities from 10,000 to 60,000 lb/hr and pressures to 1300 psi. For complete information, send for Bulletin No. PG-55-3. *Foster Wheeler Corporation, 165 Broadway, New York 6, N.Y.*

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Hall Industrial Water Report

VOLUME 5 AUGUST 1957 NUMBER 4

Many Contaminants Can Get into Boiler Feedwater

The boiler is the sump in which all solids present in the feedwater must tend to accumulate. Normally, condensate returned to the boiler is relatively pure and the usual solids in the additional make-up water are handled routinely by chemical treatment and blowdown. When unexpected contamination of feedwater does occur, quick action is necessary to avoid serious trouble due to carryover, corrosion or tube losses. The Hall engineer is specially trained to help the plant operators locate the source of the contamination and get boiler water conditions back to normal.

Get the Lead Out

When an eastern utility plant first opened a new high-pressure turbine, unexpected deposits were found on the blades in the reheat section. Even more unexpected was Hall Laboratories finding that the deposits were composed largely of lead silicate, an unprecedented constituent of such deposits.

A careful search for the source of the lead by plant engineers covered the entire boiler-turbine system and ended at the condenser. At start-up, considerable leakage had occurred between the condenser shell and tube sheets and between tube sheets and water boxes. When red lead compound was forced into the joints to seal the leaks, appreciable amounts had flowed between the tube sheets and shell into the steam space.

How did the lead get to the turbine? Slowly dissolving in the condensate, the lead oxide passed to the boiler in the feedwater, distilled off along with silica in the steam and deposited as lead silicate when decrease in temperature and pressure made the steam no longer capable of carrying it. Thorough cleaning of the steam space of the condenser was necessary to correct the problem.

Diagnosis by Odor

Hall field engineer R. M. Jordan was called to a paperboard plant to solve a bad carryover problem which had developed because of contamination of the boiler water. A major clue was an odor of burned sugar throughout the plant and in the surrounding area.

Because of previous training and experience, Jordan's first question was whether any plant operation involved the use of starch. This led directly to the department where a starch base adhesive was prepared by indirect heating with steam. There a leak in the steam coil was found which had permitted siphoning of adhesive into the condensate line when the steam was shut off. Decomposition of the starch in the boiler resulted in foaming of the boiler water and in the odor of burned sugar in the steam.

Raw Water Instead of Raw Carrots

When a foaming problem developed at an eastern food processing plant, the experienced operators looked for a leak at a kettle with resulting contamination of the condensate with some vegetable product. When they were unable to trace the problem to the usual sources they called Hall field engineer D. H. Pyle.

Pyle's first move was to analyze the boiler water. He found no phosphate even though a satisfactory amount had been reported shortly before the foaming started. Conductivity was very little greater than it had been earlier, indicating no great change in dissolved solids. However, the concentration of suspended solids was abnormally high.

The signs pointed to raw water contamination of condensate. Hardness determinations on the various condensate streams quickly revealed raw water leakage in a group of tubular water heaters. With this information the operators were able to stop the contamination and to get boiler water conditions back to normal in short order.

Anti-freeze in Boilers

Late one afternoon Hall field engineer E. A. Ramalho received a call from a mid-western food processing plant in real trouble. Total solids concentration of the boiler water was far too high. Carryover was occurring. Despite increased feeding of phosphate and alkali, adequate concentrations could not be maintained in the boiler water.

Arriving at the plant, Ramalho had the operators give the boilers more blowdown and greatly increase phosphate and alkali feeding to maintain tolerable conditions in the boiler water until the source of the difficulty could be located.

Finding the point of contamination was not easy because of the large numbers of return lines and pieces of steam condensing equipment to be checked. However, Ramalho and the operators gradually narrowed down the search. Finally, in the wee hours of the morning, they found a leak in a small exchanger heating calcium chloride brine. Arrangements were immediately made to discard the condensate from this heat exchanger and further mopping up operations were easily accomplished.

Industrial Water Problems Require Special Handling

There are no "stock answers" to industrial water problems. For information, write, wire or call Hall Laboratories, Division of Hagan Chemicals & Controls, Inc., Hagan Building, Pittsburgh 30, Pa.

Water is your industry's most important raw material. Use it wisely.

Hall Laboratories—Consultants on Procurement, Treatment, Use and Disposal of Industrial Water

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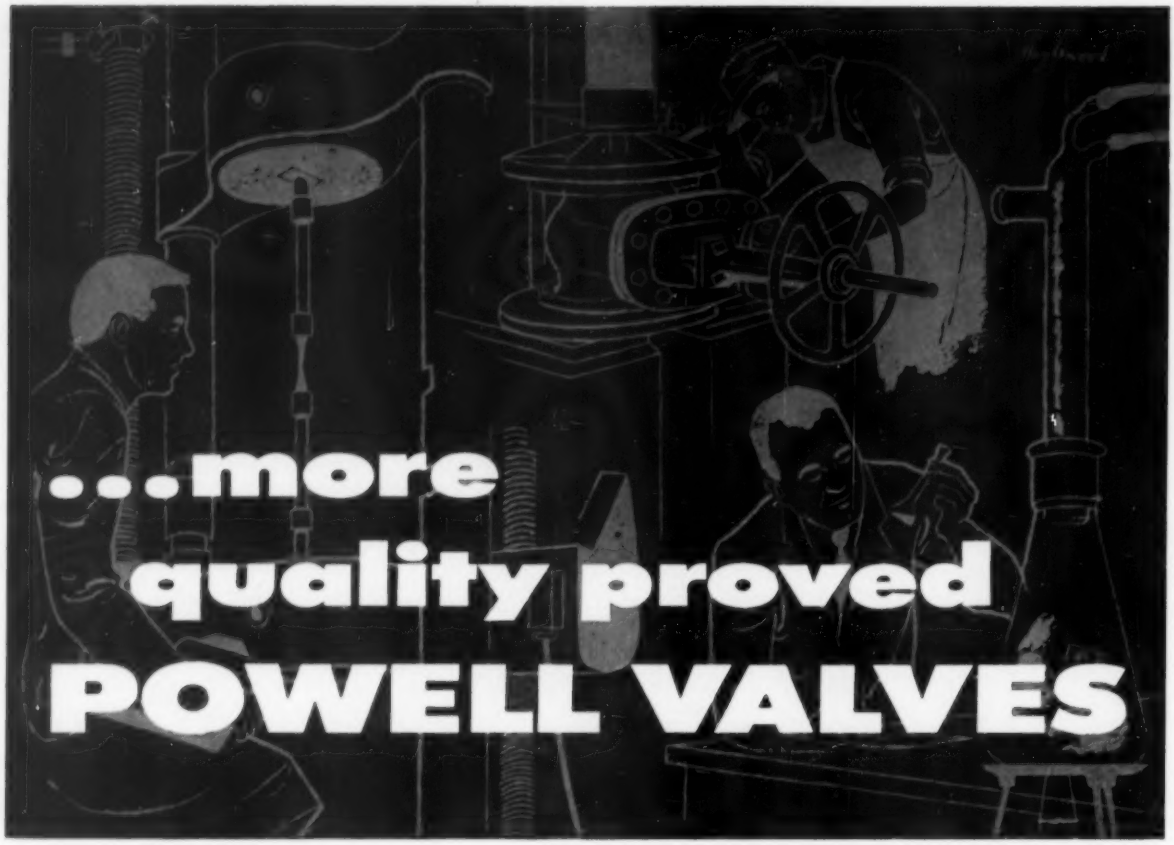


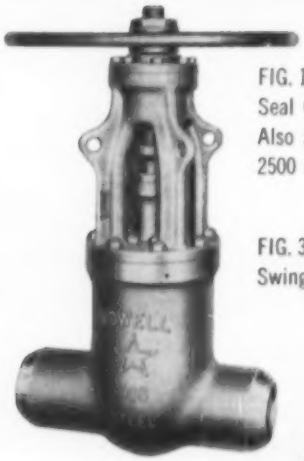
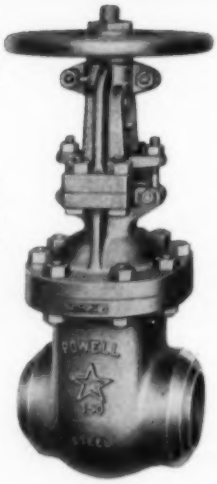


FIG. 19003 W.E.—Steel Pressure Seal Gate Valve for 900 Pounds. Also available for 600, 1500 and 2500 Pounds.

FIG. 3061 W.E.—300-Pound Steel Swing Check Valve.

FIG. 1503 W.E.—150-Pound Steel O.S. & Y. Gate Valve.

FIG. 11365 W.E.—Steel Pressure Seal Horizontal Lift Valve for 1500 Pounds. 900-Pound Valves also available.



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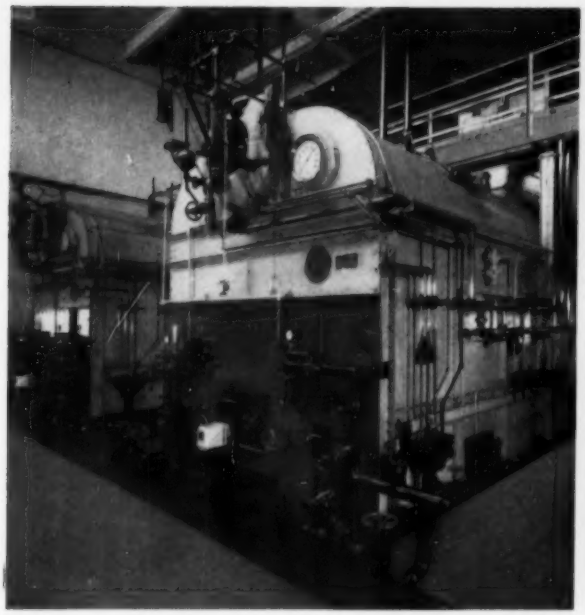

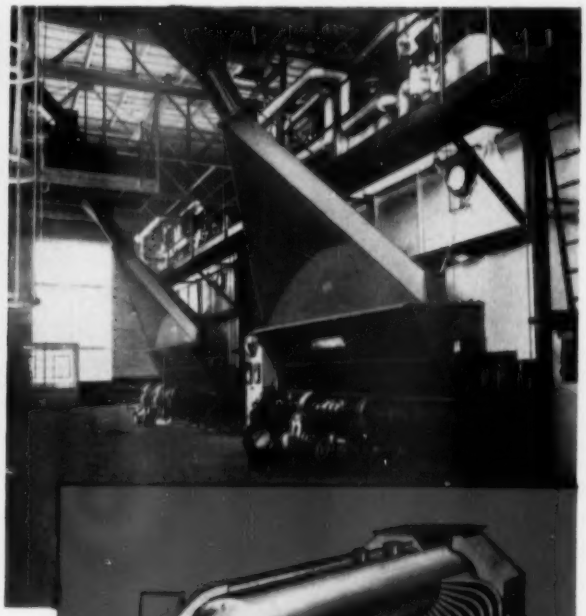

Left above—Two oil fired Keeler "CP" boilers, each with 16,500-lb. steam capacity. Right above—Two Keeler "CP" boilers, each with 60,000-lb. steam capacity, operating with multiple retort bituminous coal stokers.

In thousands of operations throughout the nation and abroad, the Keeler "CP" continues to be the "pacesetter" in providing a reliable, efficient source of low cost steam for power, process and heat requirements—with user reports like these . . .

"fuel savings of approximately $700 per month" . . ."reduction of 25% over cost of operating previous boilers". . ."operating almost continuously at 200% to 250% of rating and maintenance has been practically nothing"!

The Keeler "CP" is a fully steel encased and insulated water tube steam generator with water cooled walls. Among its many features, the "CP" water circulation occurs in a free and unrestricted flow, without the use of internal baffle plates. This permits operation at high overloads with exceptionally dry steam and no disturbance of the water level. The "CP" is readily convertible to all methods of firing, for all types of fuels—coal, oil, natural gas or waste gas.

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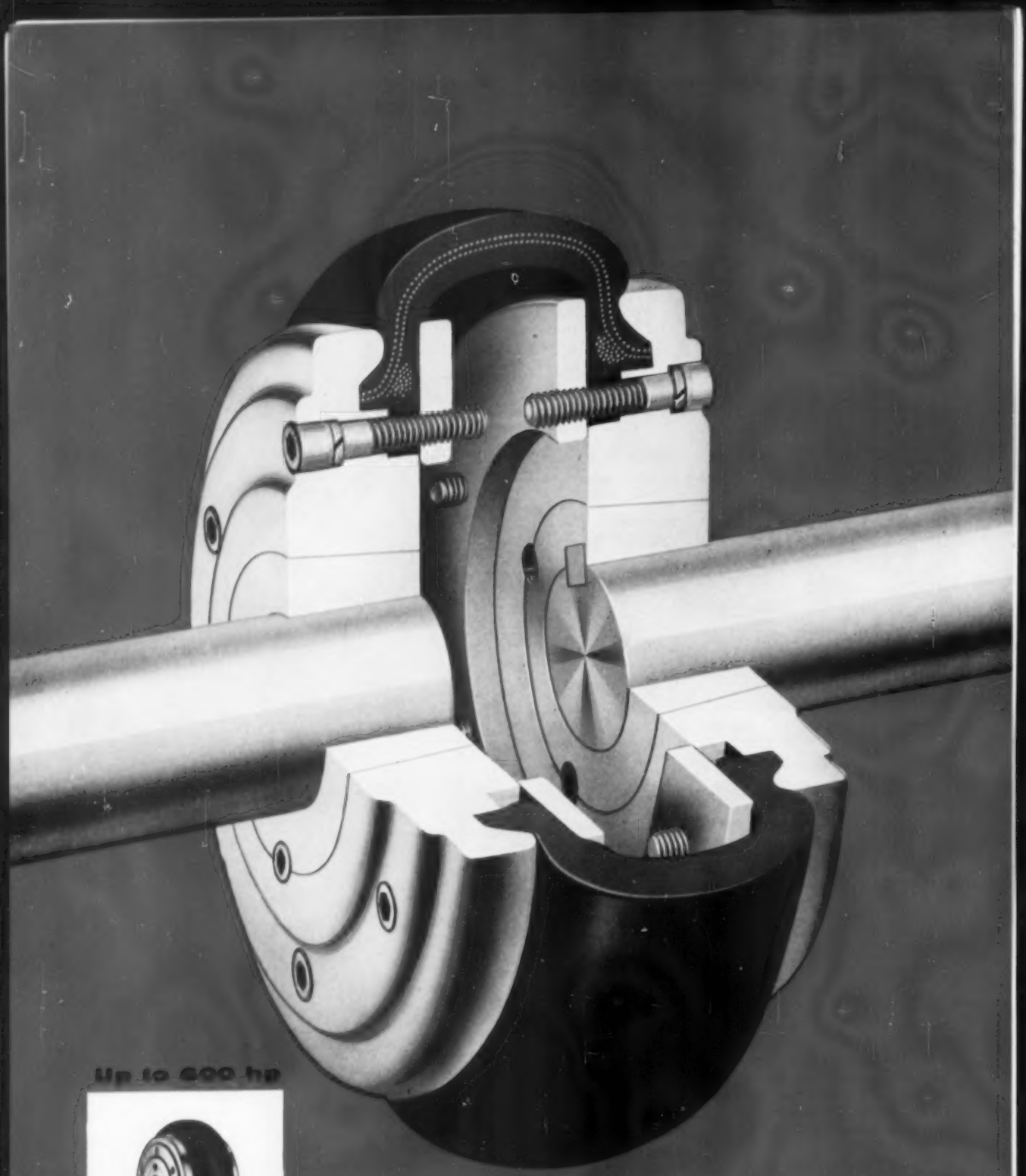
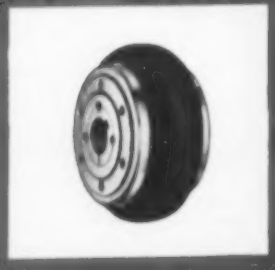


Up to 600 hp



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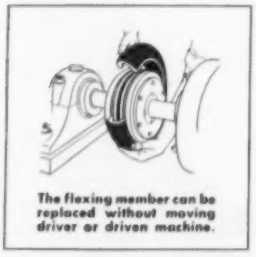
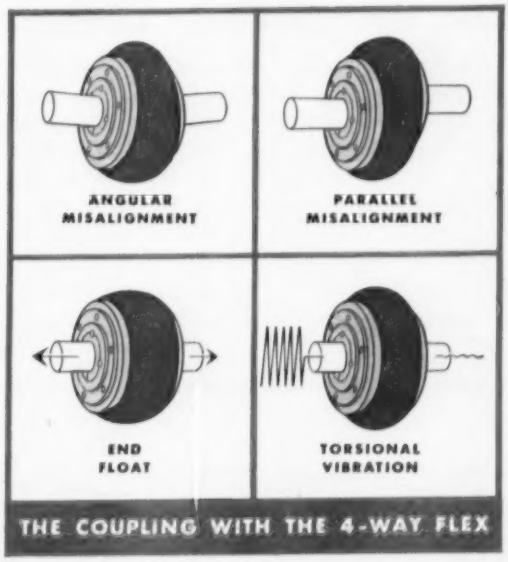


The flexing member can be replaced without moving driver or driven machine.



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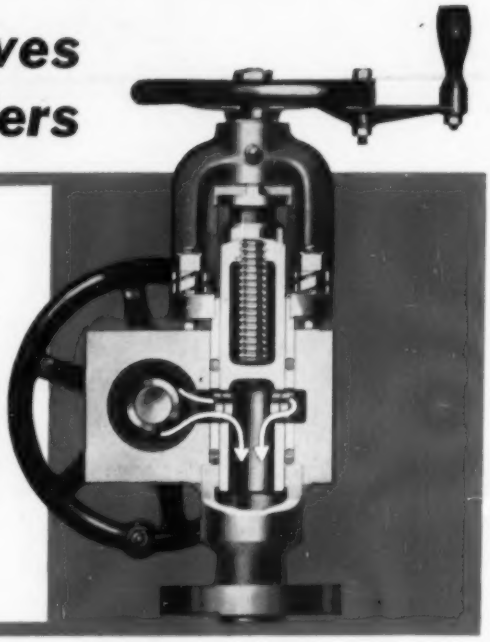
rugged blow-off valves for high pressure boilers

HARD-SEAT—SEATLESS COMBINATION

■ For boilers up to 1500 psi, this Yarway Unit Tandem Blow-Off Valve offers the maximum in dependable service. A one-piece forged steel block serves as the common body for the Yarway Stellite Hard-seat blowing valve and the Yarway Seatless sealing valve. All interconnecting flanges, bolts and gaskets are eliminated. The Unit Tandem at right is sectioned through Seatless Valve to show balanced sliding plunger in open position and free flow.



HARD-SEAT—HARD-SEAT COMBINATION

■ For boilers to 2500 psi, this is the valve to use—Yarway's Unit Tandem Hard-seat—Hard-seat combination. Disc has welded-in stellite facing and inlet nozzle has integral welded-in heavy stellite seat, providing smooth, hard-wearing surface.

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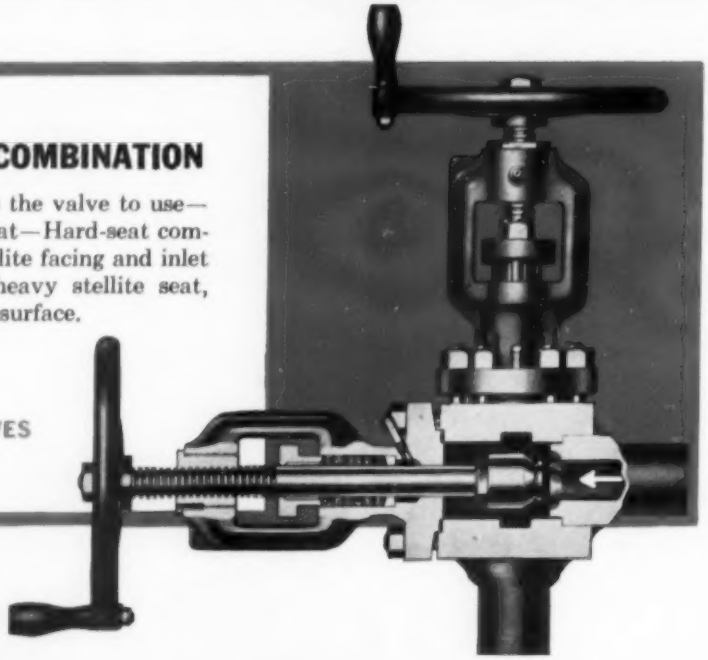

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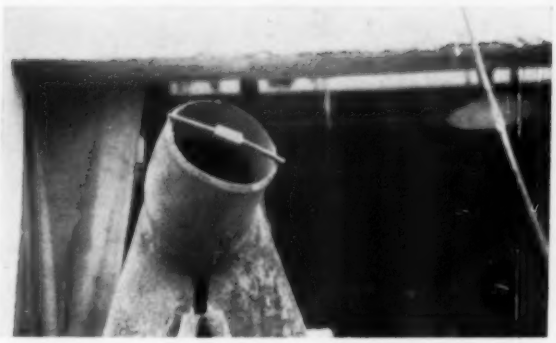


Fig. 1. Attach test coupon of key-stock to blow-off pipe

Fig. 2. After each blow, remove coupon and check looks

At Start-Up, Test Steam Line This Way

By J. H. HUNNICUTT *

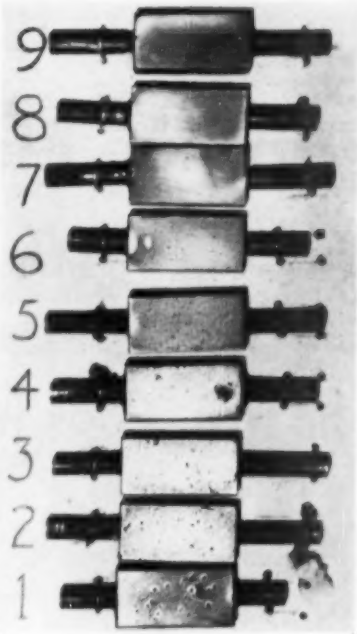
FINAL STEP in preparing any thermal generating station for operation is the cleaning of main and auxiliary steam lines and the boiler superheater by blowing through them with steam. This operation is necessary to remove any welding beads and other trash which, if left in the system, would subsequently pass through the turbine and possibly damage the turbine blading.

By this time, the boiler will have been boiled out and, if indicated, will have been acid-cleaned. If the boiler erector has been more than normally painstaking, all superheater loops will have been sounded by blowing sponges through with compressed air, and this will have effectively removed any heavier metallic debris. It now remains to remove whatever mill scale and oxide that may be present in the superheater loops and to clean steam lines to the turbine.

In accomplishing this, the normal procedure is to remove the bonnet of the turbine inlet valve, block the valve disk in position so that no steam will enter the turbine, replacing the valve bonnet with a temporary flange and blow-out pipe installed so that when blowing through with steam, there will be no danger either to other equipment or personnel. Each turbine manufacturer has a special method for blocking the valve disk in position, and instructions should be carefully followed.

Blowing of steam lines is undoubtedly the most dangerous operation involved in the readying of any new plant for operation, and the necessity of seeing that temporary blow-out piping is securely anchored, with freedom to expand, cannot be too strongly emphasized.

Until recently, the blowing of steam lines was more often than not a hit-and-miss affair. The boiler stop valve was opened, the lines blown a predetermined number of times, whereupon it was assumed that the lines were clean. The temporary piping was then removed and the unit placed in operation. Subsequent internal inspection of several machines after operating periods ranging in length from one to several years revealed that this was not enough; a method was needed that would take the guesswork out of this operation.



Blow No.	Boiler press. at beginning psig	Boiler pressure, end, psig	Duration of blow min	Appearance of coupon
1.	425	250	4½	Badly abraded
2.	425	250	4	Badly abraded
3.	550	400	5	Deep scars
4.	550	400	5	Slight improvement
5.	550	400	5½	Slight improvement
6.	600	425	5	Definite improvement
7.	700	500	5½	Minor scratches
8.	700	500	5	Very minor scratches
9.	850	500	6	Operation complete, surface unmarred

Fig. 3. After 9th blow, coupon smooth

The writer has formed a practice of having test coupons made of key-stock, polished to a mirror finish on one side, with extension rods on either end for tack welding across the end of the blow-off pipe, as shown in Fig. 1. These coupons are removed after each blow for examination and a very clear picture of the effectiveness of the operation is thus obtained. Figure 3 shows a typical set of coupons representing the cleaning operation for the No. 2 unit of Planta Tacoa for The Electricidad de Caracas, Caracas, Venezuela.

This plant is a gas-fired installation and the somewhat prolonged duration of each blow was made possible by firing the boiler with four of the eight burners with a fixed gas header pressure corresponding to 2-in. Hg. A wide-open boiler stop valve was obtained in each case and the duration of blow given represents the time interval between attaining a wide-open valve and the moment when the valve started toward the closed position. Approximately three minutes were required to open the valve fully and still maintain proper drum level conditions. Duration of each blow was actually governed by pressure drop in order to prevent excessive temperature shock to the boiler drums.

* Project Supt., The Kuljian Corp., Caracas, Venezuela.

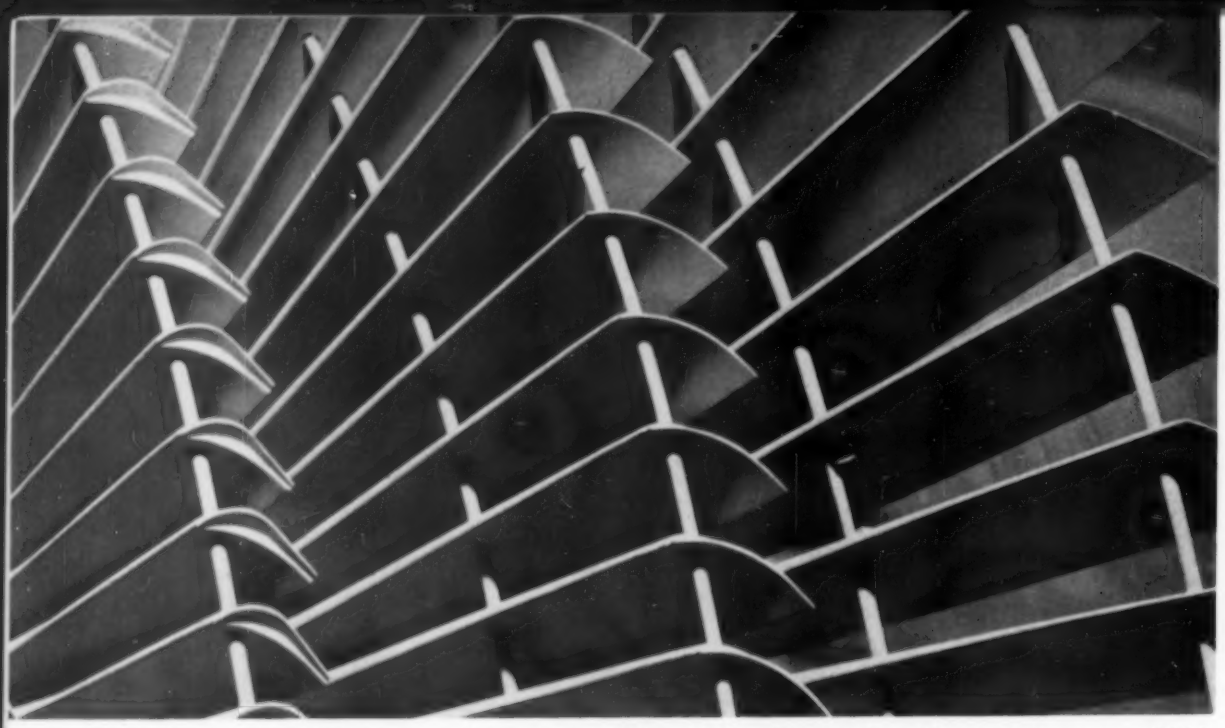


Fig. 1. Appearance of last three rows of low-pressure turbine blades after spraying with metal to increase useful life

Extend Turbine Blade Life With

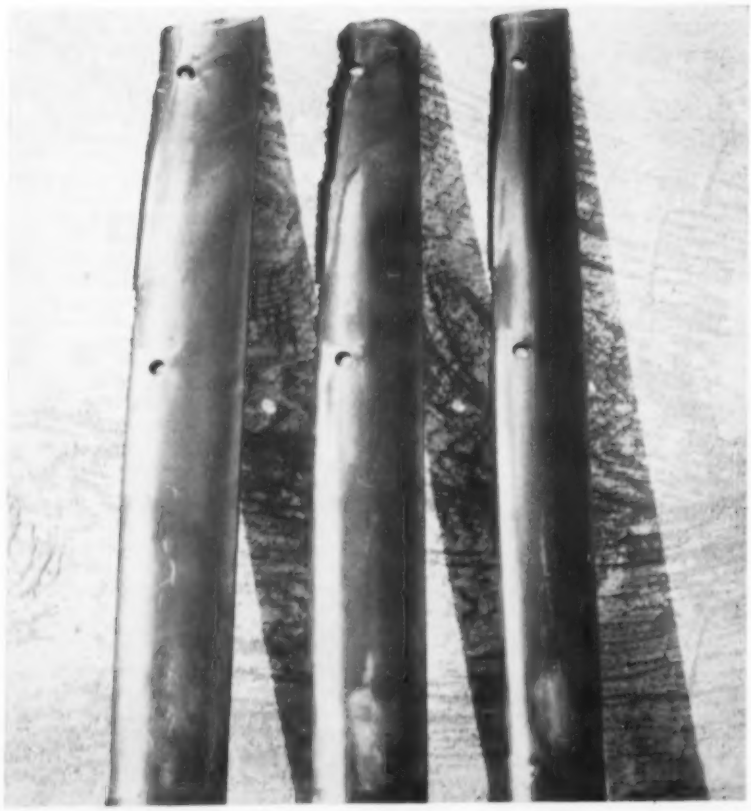


Fig. 2. Photograph shows degree of erosion on leading edges of last blade row

By G. C. PARASKEVA * and G. J. TAYLOR †

DICTATES OF economy, the ever-present rule of successful power plant operation, make the search for lower cost ways and means inevitable and constant. This article, describing a relatively inexpensive method of arresting turbine low-pressure blade erosion, may prove of value to others responsible for effective operations.

Intervals of low load operation, though undesirable, are quite unavoidable in most power station loading cycle characteristics. Such operation badly erodes the leading edge of the low-pressure stage turbine blading. Metal spraying offers a satisfactory solution to the problem of extending the life of this blading. In effect, an expendable metal coating is deposited which erodes in lieu of the blade proper. The trick is to apply sufficient metal to protect the blading between scheduled overhauls.

We became aware of this process about a year ago through the Akron Sand Blast and Metallizing Company of Barberton, Ohio. This organization has worked closely with the Ohio Edison Co on this particular metal spraying application. Based on observations at Ohio Edison's Gorge

* Supt. of Generation, † Chief Engineman in Charge of Maintenance, City of Cleveland, Division of Light & Power, Generating Stations

Fig. 3. New last-row blades after spraying, before clean-up

Fig. 4. Final and preceding row of l-p blades after spraying

Metal Spray

Station and on their enthusiasm for the process, it was applied to protect and preserve the low-pressure blading of a 25,000-kw turbine-generator unit operating at 3600 rpm, 650 psig, 850 F.

The method used in this case involved the following procedure:

1. Cleaning the leading edge portion of the blade subject to erosion with aluminum oxide particles propelled by regulated air pressure,
2. Metal spraying a base coating of molybdenum from 0.001 to 0.002 in. thick,
3. Metal spraying the final and protective coating of 4–20 stainless steel to the desired thickness,
4. Repeating the aluminum oxide air blast to clean the entire blade and remove the metal over-spray.

The "desired thickness" mentioned in step 3 above needs clarification. As indicated previously, thickness of the final coating can only be determined by experience and depends on the expected amount of erosion between overhauls of the individual turbine.

Some Blades Beyond Salvage

In this particular case the last row of blading was deemed to be beyond salvage; hence, it was entirely replaced. A tapered protective coating of the stainless steel was applied on the new blading ranging from 0.01 in. at the start of expected erosion near the root to 0.012 in. at the tip. The preceding two rows were not replaced. Here, the applied thickness varied from 0.0012 in. near the root to 0.0015 in. at the tip. These coating thicknesses will be modified as needed, depending on the results observed at the next overhaul.

One important aspect of the method is that turbine spindle unbalance doesn't occur when the metal sprayed coatings are uniformly applied on each blade in a given row. This of course implies that a skilled, experienced technician is mandatory. Through actual application and operation, Ohio Edison's experience verifies this claim. For the present, the writers will not be able to testify on this aspect, since their turbine spindle had to be drilled for future field balancing and was therefore balanced before being reassembled as a matter of course.

Technique Used for Flanges

On this particular turbine overhaul job, metal spraying was also advantageously and economically applied in the field to repair the two inlet steam flange joints. The mating surfaces of these connections were steam cut, to the point that a gasket wouldn't hold. The lower half of the high-pressure turbine cylinder was removed and turned over to make fully accessible the defective flange surfaces. Each flange surface was cleaned with the aluminum oxide blast. Then the prime coat of molybdenum was applied, followed with a coating of 4–20 stainless steel thick enough to fill all defects and steam cuts.

In smoothing and truing up these flanges, a method was improvised which worked out somewhat beyond the expectations for a field job. A spider support with adjusting capscrews for alignment was made to insert in the pipe opening. A tool holder, basically consisting of two thrust bearings and a stiff spring, was attached to the spider for rigid, 360 deg rotating operation. A Rotor-Air Grinder was placed in the tool holder. This improvised jig permitted the flanges to be finished within 0.002 in. with a six-inch cup grinding wheel. A final lapping block operation provided a true surface well within tolerances for a male-to-male gasketed joint.

Thus, for a mere fraction of the replacement costs, metal spraying can be applied to extend the life of costly turbine blading. It proved to be equally economical on the flange repair job. For the authors at least, the applications described in this article provided a happy solution to a pair of all too prevalent power plant dilemmas.

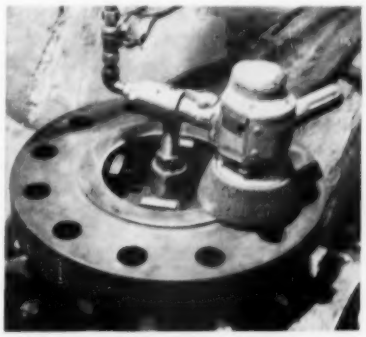


Fig. 5. Method of grinding valve flange after spraying; final job is lapping-in

What You Should Know About

Gas Pressure Regulators

Gas regulators mean efficiency, safety, overall plant economy. Here's a clear statement of fundamentals. A second article will cover regulator installation and care

By HOWARD J. EVANS*

BASICALLY, the purpose of the gas regulator is to maintain a constant pressure at all rates of flow and with variable inlet pressures. In addition, in many cases, it must act as a shut-off valve when the flow is reduced to zero. Unless the regulator closes tightly when there is no consumption, the inlet pressure will pass through the valve and on to the burner, causing a dangerous condition.

Any pressure regulator must consist of three essential parts. The first is a responsive element which is subjected to pressure which is to be controlled. This is the diaphragm of the regulator. Any change in the pressure on one side of this diaphragm will cause some movement.

Secondly, there is a standard to which the controlled pressure is referred. This standard can take the form of a dead weight, spring, or gas pressure acting on the diaphragm. In all cases this force acts in opposite direction to the force exerted by the pressure to be controlled.

Third, there is a variable restriction in the flowing gas stream which is positioned by the responsive element or diaphragm. This restriction may be in the form of a poppet valve, slide valve, piston, butterfly valve, or the like.

Figure 1 includes a schematic sketch of a gas regulator showing the three essential parts.

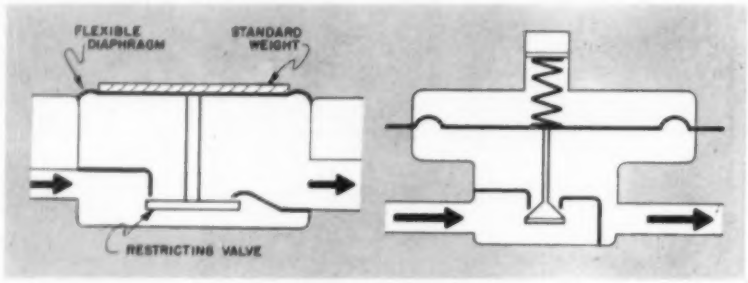


Fig. 1. Schematic of gas regulator (left) showing the three essential parts. Right shows a single-valve spring-loaded regulator, simplest kind of regulating device

Factors of Regulator Selection

When selecting a pressure regulator based upon an analysis of operating conditions and requirements, the following points must be considered:

1. *Rate of flow.* The correct sizing of regulators is very important in obtaining the maximum efficiency in a regulator. At normal loads the regulator should be operating at approximately one-half its rate of capacity. In most cases, maximum expected load and the regulator capacity should be very nearly the same. An oversized regulator will have to operate with its valves in almost closed position which will often result in erratic control or pulsation of the regulator. In an ideal situation, a regulator should not have to be operated at a flow of less than 10 per cent of its maximum capacity. Actually, many regulators must be operated down to almost zero flow. Continuous operation at low flows, however, may result in valve seat cutting, and — on sensitive regulators — there is more chance that the regulator will vibrate or pulsate.

2. *Type of gas.* On most natural gas it is desirable to use synthetic rubber materials for soft seat valves. On manufactured gas it is necessary to use leather valve disks. Liquified petroleum gas is likely to displace standard oil treatment in leather diaphragms resulting in leakage of gas. Special diaphragm treatment or synthetic diaphragms must be used with propane or butane gas.

3. *Inlet and outlet pressures.* Inlet pressures will affect the regulator type and size. The mechanical structure of the regulator must be such as to withstand the pressure, and moving parts must be constructed so as to minimize any abrasive action due to high velocity of gas through the regulator. Since in general it is desired to have the valve an appreciable distance off its seat during normal operation, higher pressure drop across the regulator means smaller size of valves for any desired flow rate. The range of outlet pressure desired determines the size of the diaphragm case. The larger the diaphragm the more responsive it will be to changes in pressure. Therefore, the largest diaphragm consistent with pressure conditions should be used.

4. *Accuracy of control.* On large regulators, different types of loading diaphragms may be used depending upon the accuracy of control needed. The simplest and most rugged design which will give the necessary accuracy should be used. For example, the weight-loaded high pressure balanced valve regulator is a simple type of regulator and should be used where the flow is very constant or the outlet pressure can vary about five to ten per cent. If better control is needed, a power pilot regulator can be used to load this regulator and obtain constant outlet pressure over a wide range of flow.

5. *Type of valves.* When a complete shut-off of flow is required, a soft seat valve should be used. On high pressure drops, the valves are subjected to erosion from the particles carried along in the gas stream. In such cases, hard seat valves should be used to help withstand this cutting action.

Factors of Regulator Performance

The performance of a regulator — how well it serves in maintaining a constant predetermined outlet pressure under conditions of variable flow rates and inlet pressures — can best be visualized by plotting the outlet pressure against the rate of flow. A theoretically perfect regulator would give a truly constant pressure at all flow rates from zero to maximum. Such a condition is shown in Fig. 2, by a horizontal line.

Actually, there are a number of mechanical factors which prevent a regulator from performing in a manner that would produce the perfectly horizontal line in Fig. 2.

As the flow increases, the valves must open wider to keep the pressure loss constant across the restriction. Referring to Fig. 1, it is evident that this means the length of the spring will increase as the valve opens wider. The length of the spring exerts a smaller amount of force. Since the standard value is decreasing as the flow rate increases — and the spring

*Chief Engineer, Rockwell Manufacturing Co.

pressure decreases — the outlet pressure must decrease accordingly. The amount of this decrease depends upon the flexibility of the spring. The regulator performance curve then drops from the theoretical value given in Fig. 2 to a value that is shown in Fig. 3. This is referred to as *spring effect.*

Another cause of variation in the performance curve, from the theoretical horizontal line, is the variation in effective diaphragm area at various positions. As the diaphragm moves down to open the valve, the effective area becomes larger. As the diaphragm area increases, less pressure is required below the diaphragm to counterbalance the force of the standard spring. The effect of this condition — known as *diaphragm effect* — is to further lower the curve shown in Fig. 3.

A third factor governing regulator performance and still further affecting the performance curve is classed as *body effect.* This is the turbulence of the gas between the restricting valve and the discharge or outlet from the regulator. With the spring-loaded regulator shown in Fig. 1, the controlled pressure is on the outlet side of the valve. A definite pressure loss exists between this point and the piping where pressure is usually measured. If the flow through the valve impinges directly on the diaphragm, the impact pressure exerted against the diaphragm tends to close the valve.

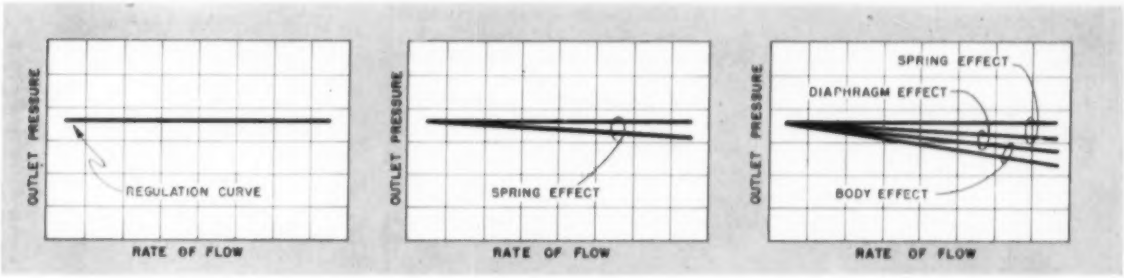


Fig. 2. This is how performance curve should look for regulator in theory

Fig. 3. But certain mechanical factors affect performance. Here's one effect

Fig. 4. The three factors which prevent theoretically perfect performance

How Variations are Overcome

Three factors which prevent regulator performance from following the theoretically horizontal line in Fig. 2 are shown as a cumulative effect in Fig. 4. The conclusion will be properly drawn that performance of the elementary regulator is not satisfactory for many control problems and that design features have to be incorporated to overcome one or all of the effects.

The spring effect can be aided by using long and flexible springs, together with large diaphragm cases. That is the feasible method on the smaller sizes. On the larger sizes, springs would become too cumbersome, so either weight or lever-and-weight is used for the standard force.

Diaphragm effect can be reduced by using larger diaphragm cases. This is most satisfactorily accomplished on low pressure regulators. On high pressure regulators the diaphragm cases would be too heavy, the diaphragm material too thick, and the counterbalancing weights excessive. In the case of high pressure regulators, the standard weight or spring is replaced by a constant gas pressure so that change in the diaphragm area will not cause any variation in the controlled pressure.

The body effect is caused by static pressure changes from the point of control to the piping, due to friction loss or velocity change. The friction loss cannot be overcome, but it is possible to utilize the knowledge that static and velocity pressures are inversely proportionate. Frictional loss in pressure can be eliminated by placing the control line to the diaphragm case in the downstream piping and, at the same time, gas impingement directly on the diaphragm will be eliminated.

With the establishment of practical means of overcoming spring and diaphragm effects, body effect can be overcome by adopting the principles observed in pressures passing through a venturi.

Total pressure in a gas line is the sum of static pressure and velocity pressure. Neglecting friction loss, if velocity pressure is increased due to area reduction in the line, static pressure is decreased. The amount of drop in static pressure depends upon the volume of gas passing through. If minimum static pressure were held constant with the regulator, then pressure in the downstream line would increase as flow increased.

Inlet Pressure Effect

Outlet pressure of the regulator is also affected by inlet pressure changes. In the single valve construction shown in Fig. 1, the inlet pressure acts upward on the valve, creating a force opposed to the standard loading. Any increase in inlet pressure will therefore tend to decrease the standard loading and thereby the outlet pressure. This can be minimized by the use of large diaphragms or by leverage arrangement between the valve and the diaphragm. For small inlet pressure changes a single valve regulator with a suitable diaphragm is entirely satisfactory, while regulators subjected to greater inlet pressure changes make use of a leverage system.

When greater accuracy control is needed, the inlet pressure effect must be eliminated. This can be done by using balanced valves, seal diaphragms, or special types of air loading. Figure 5 (next page) is double valve with inlet pressure entering between the two valves. Since the pressure pushes up on one valve and down on the other, the forces are cancelled. The double valve construction is used on almost all large sizes of regulators, both in low pressure and high pressure work. A seal diaphragm, having the same effective area as the valve, can be used to balance out the force exerted by the inlet pressure. This construction is simple and eliminates the trouble encountered when having two valves seat at the same time, but can only be used on relatively low pressure drops across the control valve.

Small Flow Characteristics

The regulation curve at small flows depends upon whether soft or hard seats are used and the power available for positioning of the valve. In order to obtain complete shut-off of gas, it is necessary to use soft seat valves, but the regulation of small flows is not as good as that obtained with hard seats. This is because of the extra force necessary to flatten out any minor ridges in the valve material. If the lock-up is of importance, a leverage system is generally used between the diaphragms and the valve in order to obtain more force for closing the valve.

To obtain better regulator performance it is often necessary to use some type of air loading for auxiliary control. Probably the most simple type is one in which the spring or

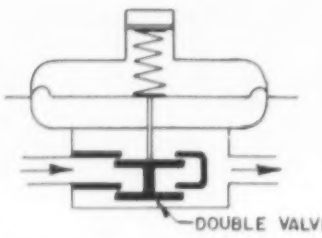


Fig. 5. Double valve with inlet pressure entering between the two valves. Used on large regulators

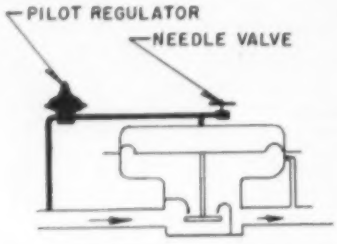


Fig. 6. This system is adaptable to high outlet pressure controls. Pilot regulator operates at a constant flow

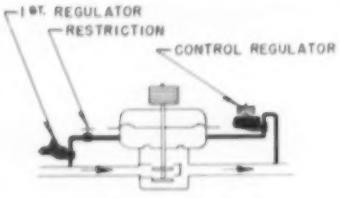


Fig. 7. Pilot control system improves large regulators operating at low pressures. It gives a better shut-off

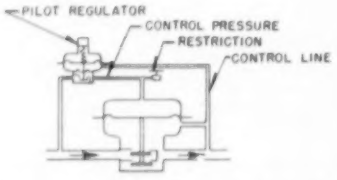


Fig. 8. Combination pilot loading and pilot control gives additional force for operating the regulator

weight is replaced by a constant gas pressure.

This can be done by trapping the pressure in the diaphragm case or maintaining the pressure constant with a small capacity regulator, Fig. 6. This system is particularly adaptable to high outlet pressure controls. A flexible diaphragm can be used because there is no pressure differential across the diaphragm. The small pilot regulator operates at a constant flow and can therefore maintain a very constant pressure on the diaphragm head of the main regulator.

With a constant standard force and no effect from diaphragm area changes, this type of regulator will hold a very constant pressure. About the only cause for poor regulation would be friction in the diaphragm and valve stems which would keep the valves from maintaining their proper position. Any unbalance of forces around the valves due to the gas turbulence would also change the outlet pressure.

Pilot Control System

On large regulators operating at low pressures, the direct weight-loaded regulators maintain a very constant outlet pressure because of the large diaphragm area. Direct gas loading would be of very little advantage. The most need for improvement in this regulator is a better shut-off and more positive position of the valves when friction occurs due to dirty gas.

This can be accomplished by a pilot control system, Fig. 7. The first pilot regulator is set for a pressure which is much higher than the desired outlet pressure and feeds through a restriction into the main control case and then through the final pilot regulator. This final regulator is set for the same outlet pressure as needed at the outlet of the main regulator. The main diaphragm case is loaded for a higher pressure than the outlet pressure desired but lower than the setting of the first regulator.

In operation, if the outlet pressure goes too high, the final pilot regulator starts to close, restricting the flow and thereby building up pressure under the main diaphragm and closing the main valves. A slight change in outlet pressure will cause a relatively large change in pressure in the control chamber. With this multiplication of power the regulator has a very good lock-up characteristic and plenty of power to overcome a sluggish condition due to dirt accumulation.

The pilot control system is not too satisfactory on high pressure control because the gas pressure is only on one side of the diaphragm. This requires a thick diaphragm when operating on high pressure, which detracts from the regulator sensitivity.

Power Pilot Control System

A combination of pilot loading and pilot control can be obtained by controlling the outlet pressure of the pilot loading regulator from the outlet pressure of the main line. Figure 8 is a schematic drawing of this type of gas loading control. If the outlet pressure in the main line decreases, the pilot regulator opens up, increasing the pressure on top of the main diaphragm head. This forces the main valve wider open, increasing the outlet pressure.

This type of system gives additional force for operating the regulator, since the loading pressure does not remain constant but changes according to the demand for more or less pressure in the discharge line. A thin and flexible main diaphragm may be used since there is very little differential pressure necessary across the main diaphragm.

Instrument controlled pressure regulators are another source of pressure loading. This system is almost identical to a pilot control except that it is more flexible, using a pressure element to position the pilot valve rather than using a diaphragm type of pilot regulator. The pressure element is operated by outlet pressure in the main line. As the pressure decreases the coil moves the flapper valve, shutting off the nozzle flow and increasing the pressure in the line. This increases the pressure in the bellows, which will move to close the valve in the supply line, thereby reducing the pressure in the control head. The spring under the main diaphragm will then move to open the valve, restoring pressure on the downstream side.

Instrument loading and pilot control are similar, having a multiplication of power for positioning the valve. The pressure acts on only one side of the main diaphragm in both cases.

COMING NEXT MONTH

Reasons for variation in the outlet pressure of gas regulators; causes for excessive increase in outlet pressure at low flows; and many another points important for the power engineer to know on maintenance of gas pressure regulators.

Economics of Driving a Shaft

Problem of selecting a suitable type of drive for a particular application is often beset by economic factors of varying degrees of complexity, discussed in this study at the annual meeting of the Petroleum Electric Association at Amarillo, Texas, early in June.

By BRAC BIGGERS*
and
ROGER OWEN*

MANY PEOPLE have occasion to determine the most economical way to drive a shaft. This is not always easy because of the many different factors upon which the selection of a suitable type of drive may depend.

The electric motor and the internal combustion engine are by no means the only ways to turn a shaft, but they are the most common and so are the only types of drives to be considered here.

Internal combustions can be grouped in three classes, as follows:

1. Automotive type engine (a) 1500–3000 rpm. (b) 0–100 Bhp.
2. Industrial type engine (a) 600–1500 rpm. (b) 50–800 Bhp
3. Stationary type engine (a) 120–600 rpm. (b) 300–2500 Bhp.

What costs are involved in choosing a prime mover? Five separate classes of costs are listed as follows:

1. Initial investment.
2. Investment costs. (a) Interest. (b) Depreciation. (c) Ad valorem taxes and insurance.
3. Operating costs. (a) Labor — including housing and transportation. (b) Fuel or electricity. (c) Parts — oil filters, etc. (d) Supplies — oil, grease, etc.
4. Maintenance costs. (a) Labor. (b) Parts. (c) Down-time costs — if applicable, and production lost, if applicable.
5. Miscellaneous. (a) Safety or other special equipment required, if any. (b) Income tax considerations.

Now, certain typical values for some of these costs will be set forth. These values were arrived at by studying the operating records of various industrial firms. They may be considered average, and may be used as guide posts but not necessarily binding for any particular case.

I. Electric Motor Drive: 1. Initial investment varies from $20 to $50 per Bhp including controls. Transformers add $10 to $15 per Bhp.

2. Investment cost, per annum. (a) Interest — about 6 per cent of investment for industry. About 3½ per cent for public bodies. (b) Depreciation — 4 per cent is about right for motors, unless faster depreciation is desired for financing purposes.

3. Operating costs, per annum. (a) Power cost = Bhp x 0.746 x hours per yr running time x rate per kwh. (b) Labor and material = about $0.25 per Bhp per yr total.

$$\frac{\text{Bhp} \times 0.746 \times \text{hours per yr running time} \times \text{rate per kwh}}{\text{eff.}}$$

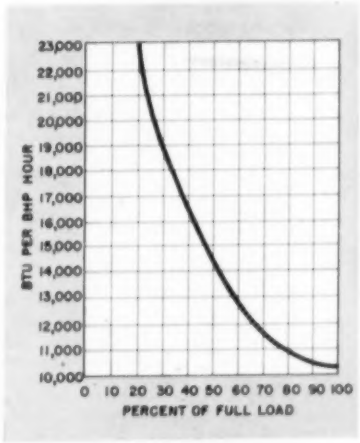


Fig. 2. Curve of fuel consumption of gas engines of small bore—below 7 in.

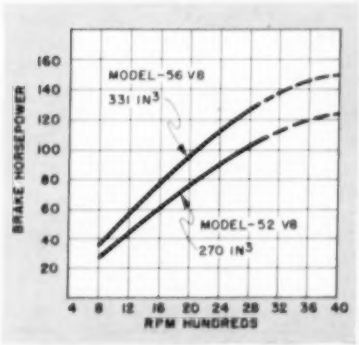


Fig. 1. Curves of brake horsepower vs speed for Chrysler Industrial Engine

II. Automotive Engine: 1. Initial investment varies from $20 to $30 per Bhp. It should be noted in these calculations that Bhp depends considerably on the engine speed. Figure 1 is included to show this relationship for a typical automotive engine.

2. Investment cost — Per Annum. (a) Interest — 6 per cent, usually. (b) Depreciation — 20 per cent to 40 per cent depending on use factor, speed, and load. This machine is usually worn out after 8000 to 15,000 hrs at full load and rpm. It will last twice as long at 2000 rpm as at 2800 rpm, and will last twice as long at 60 per cent load as at 100 per cent load. (c) Ad Valorem Taxes and Insurance — 2 per cent of total prime mover investment.

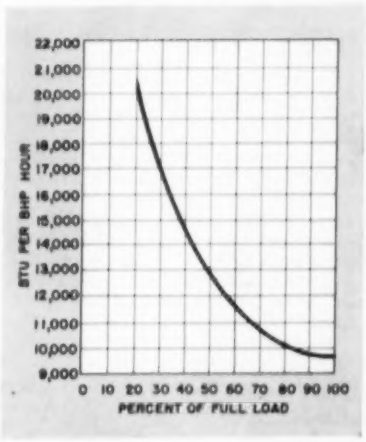


Fig. 3. Curve of fuel consumption of gas engines of large bore—above 7 in.

3. Operation Costs, per Annum. This cost varies considerably with speed, load, skill of operator, etc. Fuel is fairly easy to estimate accurately. Figure 2 is a graph showing fuel consumption for various loads. Note that the fuel use per Bhp per hr is 142 per cent as much at 50 per cent load as that at full load. Total operation costs average from $10.00 to $16.00 per Bhp per yr.

4. Maintenance Costs — Per Annum. Usually an overhaul will be needed each 6800 hr of loaded duty at 2000 rpm. Average total maintenance costs vary from $8.00 to $12.00 per Bhp per yr.

III. Industrial Engine Drive: 1. Initial Investment — installed cost is about $75.00 per Bhp. (Installed cost of engine plus all generation equipment for a generating plant = about $200.00 per kw)

2. Investment Costs — Per Annum. (a) Interest — about 6 per cent. (b) Depreciation — 10 per cent to 15 per cent. (c) Ad valorem taxes and Insurance — 2 per cent.

3. Operation Costs — Per Annum. (a) Fuel — See Figures 1 and 2. Total operation average $8.00 to $12.00 per Bhp per yr.

4. Maintenance Costs — Per Annum. Overhaul every 20,000 loaded hours at 600–800 rpm. Total maintenance costs average about $7.00 to

*Southwestern Public Service Company

$9.00 per Bhp per yr as general rule.

IV. Stationary Engine Drive: 1. Initial Investment — installed cost. of engine and accessories — about $125.00 per Bhp. (Cost of generating plant with this engine — $300.00 per kw)

2. Investment Costs — Per Annum. (a) Interest — about 6 per cent. (b) Depreciation — 4 per cent to 6 per cent. (c) Ad valorem taxes and insurance — 2 per cent.

3. Operation costs — Per Annum. Varies between $4.00 Bhp per yr and $10.00 per Bhp per yr. For fuel see Figure 3.

4. Maintenance Costs — usually about $2 to 6/Bhp per yr.

V. Miscellaneous cost considerations: Check to see what, if any, special safety or alarm equipment may be needed for each particular type of drive.

To get true operation costs be sure to evaluate the effect of income taxes on operation costs. Since this item is deductible, the true economics have not been arrived at until costs *after taxes.*

For example — if one type drive "A" has an operation cost of $10,000 per year, and another type of drive "B" costs $5,000 per year — the cost after taxes may be $5000 for type "A" and $2500 for type "B".

IV. Labor Costs — Per Annum. This cost is often underestimated, and deserves some discussion here. Most of us realize that an employee costs more than the pay check shows — but often we do not realize how much more. The following costs should be considered:

1. Fringe benefits (vacations, sick leave, F.O.A.B. taxes, jury duty, insurance, retirement, etc.). This cost is now averaging about $1000.00 per employee per year in industry, and it is steadily increasing.

2. Personnel and Supervisory Costs: This includes costs of training, supervising, and the cost of people who perform personnel functions. We cannot assume that another employee will cost nothing extra here, for it simply doesn't work out that way. *Each* employee must assume his proportionate share of this cost when economic facts are faced.

3. Housing — includes residence, if supplied, and office space, if supplied. Office space usually costs about $5.00 per sq. ft. to buy, and residences about $10.00 per sq. ft. This should be amortized at about 12 per cent to 15 per cent per annum cost.

4. Transportation — if supplied. Fairly accurate data is readily available for cost of each type of equipment, either on a per mile or per month basis. The average miles per year for passenger equipment is about 15,000 to 18,000 miles.

This total cost of an employee can be arrived at by multiplying the wage by a factor — about 1.3 if no housing, transportation or office space is required. It can go as high as 2.5 if all these things are supplied.

Case 1

An actual industry-owned generating station cost study prepared in 1951. A factor of 1.15 has been applied to operating costs to convert to 1956 dollars. These figues are from the accounting records of the company.

4–300 kw Machines—1600 HP
Generated 7,047,000 kwh
Load Factor is 70 per cent

1. Investment Costs—$264,000 ($220 per kw capacity)			
a. Interest	6%		
b. Depreciation (medium speed engine)	10%		
c. Tax (Ad Valorem)	1%		
	17%		$44,880.00
d. Insurance and expenses			1,288.00
Total investment costs			$46,168.00
2. Operating Costs			
a. Labor		$27,848.00	
b. Lubrication & Supplies		2,904.00	
c. Fuel (Gas at 10¢ per MCF)		13,665.00	
Total operating cost			$44,417.00
(Total plant operating cost—$44,417.00 / 1600 = $27.70 per BHP per yr)			
3. Maintenance Costs			
a. Labor		$ 1,224.00	
b. Material		10,329.00	
Total			$ 11,553.00
Total plant maintenance = $11,553 / 1600 HP = $7.20 per BHP/yr			
Total annual cost			$102,138.00
Rate = $102,138.00 / 7,047,000 kwh = 1.47¢ per kwh			

The above figures do not include labor costs above wages. Missing costs include such fringe benefits as housing and transportation, plus supervision and personnel costs.

Using these same figures, and a typical power company rate, compare this cost to that of purchased power.

Annual energy purchased			7,047,000 kwh
Cost of gas at generating station			12.5¢ per MCF
Load Factor 70 per cent			
Average monthly usage		587,250 kwh	
Energy chg. per mo		$5901.50	
Annual cost			$70,818.00
Investment costs based on $10.00 per kva Substation capacity (1500 Kva—$15,000)			
Annual fixed charges and substation Maintenance	16 %		$ 2,400.00
Transformer losses	2½%		1,770.00
Total cost			$74,988.00
Cost per kwh = $74,988.00 / 7,047,000 kwh = 1.065¢ per kwh			

Case 2

The Kansas City Power and Light Company prepared a competitive Power Cost Study in 1955. The following two tables are taken from this report.

This illustration is given to show the extreme importance of including the probable load factor of a station when making an economic study.

It should be noted that the two sources of power approach the same cost at 100% load factor, but due to high fixed charges the kwh cost of engine generation goes up much faster at lower load factor.

TABLE I

Total Cost of Generated Power With
450–600 Rpm Diesel Engine Generators

LOAD, KW DEMAND	100		500		1000		1500		2000	
Investment per kw*	$290		$260		$237		$230		$221	
Total Cost, Mills per kwh										
Labor Allocation	100%	50%	100%	50%	100%	50%	100%	50%	100%	50%
Load Factor										
20%	350.5	218.9	88.0	74.1	75.6	68.7	61.8	55.7	53.8	49.3
30%	237.2	190.7	61.5	52.2	53.2	48.6	44.0	40.0	38.7	35.6
40%	180.0	145.2	48.2	41.2	42.0	38.5	35.1	32.1	31.1	28.8
50%	145.7	117.8	40.2	34.6	35.2	32.4	29.7	27.3	26.6	24.8
60%	122.8	99.6	35.0	30.3	30.9	28.5	26.2	24.2	23.5	22.0
70%	106.5	86.6	31.2	27.2	27.7	25.7	23.7	22.0	21.4	20.1
80%	94.2	76.8	28.3	24.9	25.2	23.4	21.7	20.2	19.8	18.6

* Per Kilowatt of Plant Capacity

TABLE II

Total Cost of Purchased Power With Kansas City Power and Light Company Rates

LOAD, KW DEMAND	Primary, 12,000 Volts or Over					General Service—Large				
	100	500	1000	1500	2000	100	500	1000	1500	2000
Investment Per kva	$51	$15	$13	$10	$10	—	—	—	—	—
Total Cost, Mills Per kwh										
20% Load Factor	33.3	27.2	25.4	24.3	22.8	31.1	27.8	25.2	24.4	24.0
30% " "	26.0	21.9	30.8	20.0	19.0	24.8	22.6	20.9	20.3	20.0
40% " "	21.9	19.0	18.0	17.4	16.6	21.2	19.5	18.3	17.8	17.6
50% " "	19.5	17.0	16.4	15.9	15.1	18.8	17.5	16.5	16.2	16.0
60% " "	17.4	15.3	14.7	14.2	13.6	16.9	15.8	14.9	14.7	14.5
70% " "	15.6	13.9	13.4	13.1	12.5	15.5	14.5	13.8	13.6	13.5
80% " "	14.5	13.0	12.6	12.3	11.8	14.4	13.6	13.0	12.8	12.7

CASE 3—Diesel Generating Plant for Small City, New Mexico

1. Physical Facilities
   5 engines and generators—capability at altitude = 940 BHP total
   Engine HP at altitude = 1515 total = 85% manufacturers rating
   All are slow speed (200 to 300 rpm)
   They average about 13 years of age
2. Operating Date—12 months ending August 1956
   Total net kwh = 2,507,289
   KW Peak = 695 kw = 930 BHP
   Annual Load Factor = 41%
   Load usually carried by 2 most efficient machines and 1 other
   Total Plant operation cost = $54,861.64 = $36.00/engine HP/yr
   Total Plant Maintenance Cost = $12,064.33 = $8.00/engine HP/yr

   Total operation and maintenance cost per kwh = 2.669¢
3. The above figures do not include labor overhead or any investment cost. If we add $5000.00/yr for labor overhead ($1000.00 per man for 5 men), then add 5% for interest, 5% for depreciation, and 2% for insurance and taxes on an investment of $200.00 per kw for 940 kw we get about $25,000.00 more. Then

$66,925.97
25,000.00
$91,925.97 = Total Cost
or
this is 3.65¢ per kwh generated

CASE 4 COMPRESSOR STATION ECONOMICS

HYPOTHESIS:
1—8000-hp Gas Compression Station—to be designed to utilize most economical drive for compressors. Assume 50% for bond ratio of company, and 3.5% bond interest. Assume rate of return on money (average) to pay investors 6%.

	Electric Motor Drive $150—175 per hp Cost of Station Use $150		Gas Engine Drive New Supercharged Engines 1956 Model $250—275 per hp Cost of Station Use $250	
Cost of Plant		$1,200,000		$2,000,000
Spare Parts Inventory		20,000		30,000
Total Investment		$1,220,000		$2,030,000
Interest	6%		6%	
Depreciation	5%		5%	
Ad Valorem Taxes and Insurance	2%-13%	$ 158,500	2%-13%	$ 264,000
Therefore—Cost of Money is		$ 158,500		$ 264,000
	Operating Costs—Including Maintenance			
Fuel (or Elect.)	8000 hp (0.746 kw per hp) (8760 hrs per yr) (.80 load factor) ($.0085 per kwh) ÷ .9 efficiency =	$396,000	8000 hp ($.20 mcf) (8000 btu/hp) (.80 load factor) (8760 hrs/yr) ÷ .93 altitude factor (1000 btu per mcf) =	$96,500
Labor, Parts, Supplies, etc.	Six Pipe-Line Companies (names on request) average $2.50 per hp per yr for this item —8000 ($2.50) =	$ 20,000	Same Six Pipe-Line Companies average $14.00 per hp per yr for this item—8000 ($14.00) =	$112,000
Admin. & General Expense @ 3½%		$ 42,700		$ 71,000
Total Operating Costs		$458,700		$279,500
	Electric Motor Drive		Gas Engine Drive	
	Income Tax Cost—To Allow 6% Return			
Bonding Interest Deduction	$1,220,000 (.50) (.035) =	$ 21,350	$2,030,000 (.50) (.035) =	$ 35,500
	Net Income After Taxes Needed =			
	(.06) ($1,220,000) =	73,200	(.06) ($2,030,000) =	121,800
		—21,350		—35,500
	48% =	$ 51,850	48% =	$ 86,300
	52% (Tax) =	$ 57,150	52% (Tax) =	$ 89,900
		$ 57,150		$ 89,900
		458,700		279,500
		158,500		264,000
Total Annual Costs		$673,350		$633,400

Difference in Annual Cost = $673,350 − $633,400 = $39,950
Difference in Investment = $2,030,000 − $1,220,000 = $810,000
Now management can decide whether $40,000 more cost per year is best for the smaller investment or whether to make the larger investment. Other things they will consider are possible automation advantages of each choice, future cost of labor, etc.

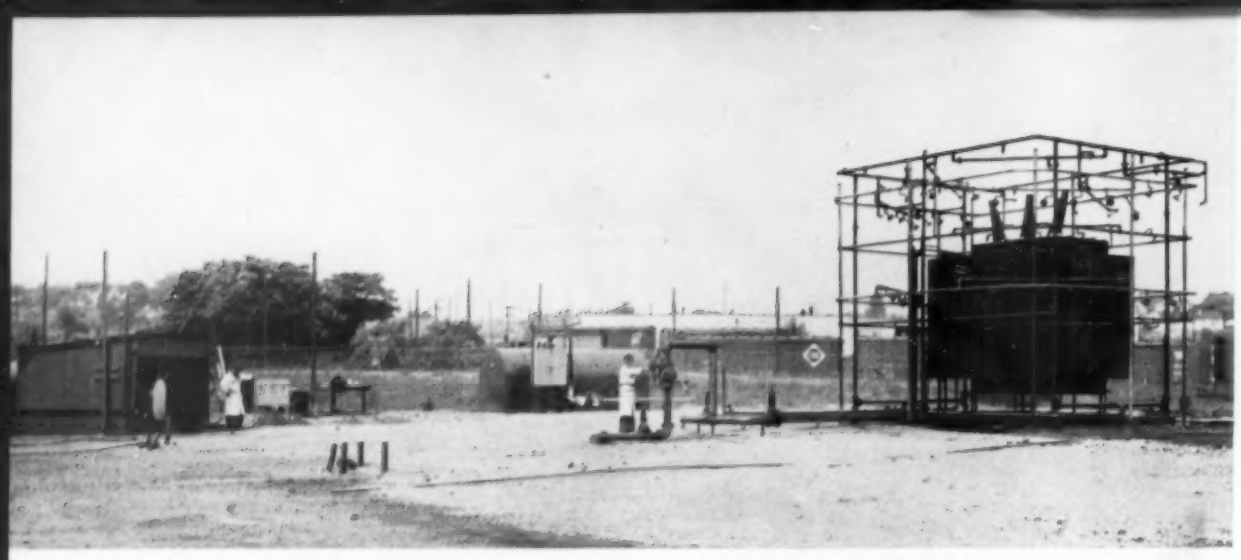


Fig. 1. View of transformer fire test area shows replica of typical 20,000-kva transformer at right, liquid CO_2 storage unit in center, oil storage and heater in shed at left. The operator mans deluge valve which supplies water to system

EVALUATION PROGRAM LETS YOU

Test Transformer Fire Protection Before

NOW YOU can tell how effective your transformer fire protection will be before you have to learn the hard way — after a fire. Automatic Sprinkler Corp has begun a transformer fire protection evaluation program, including demonstrations of actual transformer fires, for personnel of utilities, industrial firms, insurance companies, and consulting firms.

Purpose of the program is to provide information on the various types of protection systems available and show what performance may be expected of each. It is hoped that the program will provide users with a better background for specifying and purchasing transformer fire protection.

Feature of the programs is the demonstrations conducted on a full-scale model of a transformer. Oil similar to that used in transformers is piped to five different locations on the model; when the oil is set afire at any one of the locations, the effectiveness of a given system of nozzles and nozzle arrangements can be judged accurately.

As shown in Fig. 1, the test area at the company's plant in Youngstown, Ohio, consists of the dummy transformer surrounded with a piping system to accommodate the various nozzle configurations, a storage unit for liquid CO_2, and a facility for heating the test oil to 350 F, necessary to assure ignition.

The day-long program includes discussions and films of dry chemical systems plus demonstrations of auxiliary equipment such as "rate-of-rise" detection units. Each program covers the three basic types of transformer protection systems:

1. *Engineered Fire Protection System:* This is an automatic system designed to obtain quick extinguishment or control of fire. Such a system is supplied with at least a 30-min. supply of extinguishing medium, and is designed to allow resetting to full fire protection immediately after a fire. Systems in this class are: (a) properly-designed water spray systems for indoor or outdoor use, and (b) total-flooding CO_2 systems in enclosures where concentration can be held for 30 min. with a second shot of CO_2.

2. *Limited Supply Protection System:* This is designed for positive extinguishment. Supply of extinguishing medium may be between one and three minutes. System may use CO_2 or water spray. Design and conditions of use must make positive extinguishment possible since these systems cannot cope with reflash which may occur from fire beyond area covered by system, or from oil above its ignition point still discharging from transformer.

3. *Auxiliary to Hose Station System:* This is a fixed-piping system, manually or automatically-operated, consisting of several water spray or dry chemical nozzles so located as to extinguish fires on top of the transformer only. Fires in other locations require extinguishment, if pos-

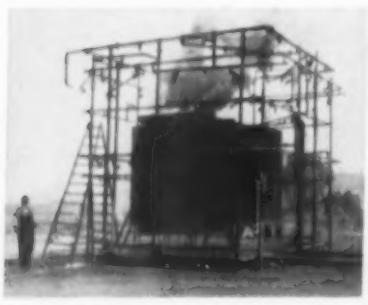


Fig. 2. Simulating fire on transformer top, hot oil burns fiercely in Test A-1

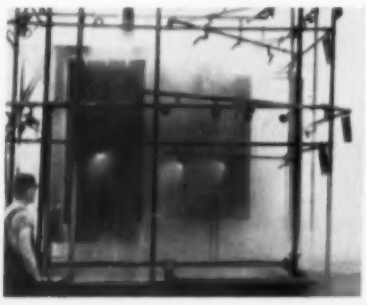


Fig. 3. Fog spray from double row of nozzles blankets fire in series D test

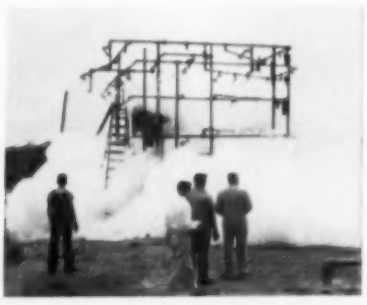


Fig. 4. Here, cloud of CO_2 envelopes transformer in test of Cardox system

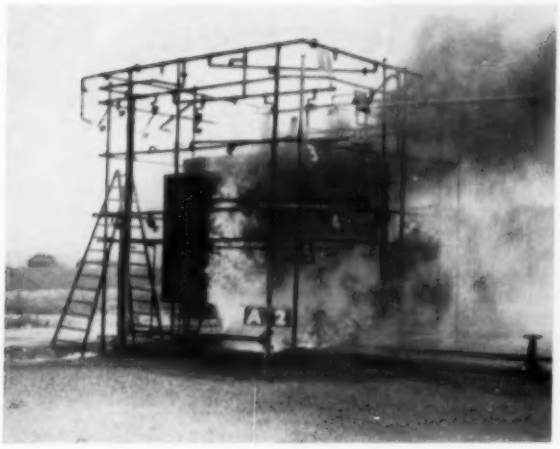


Fig. 5. Test A-2 demonstrates effectiveness of top-mounted row of nozzles against simulated fire on side of radiator

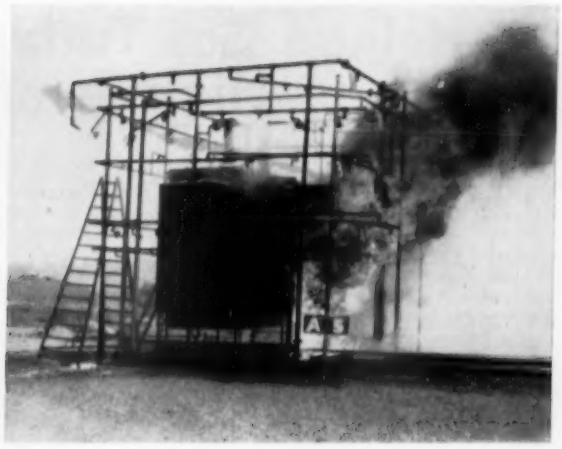


Fig. 6. Test A-5 is made with same spray nozzle configuration, but with fire in different location on front radiator

You Buy

sible, by portable hoses or extinguishers.

Each water spray system is tested against five fires. Performance is evaluated in terms of two questions: Did the system extinguish the fire, and if so, how much time was required? Observers make their own decisions as to whether or not each fire has actually been extinguished, and do their own timing (See Fig. 7). This enables them to make their own conclusions as to the degree of protection they can expect from whatever system or systems they are considering purchasing.

Test program has been worked out in over a year of experimentation by special hazards experts of the company, and by condensing this experience into a day-long program, it enables observers to learn in a few hours what would otherwise require months of experiments and thousands of dollars. The demonstrations and discussions cannot go into the complexities of system design, but are intended to give a thorough background for purchasing decisions.

Programs will be conducted each week throughout the summer and fall, and are open to all interested personnel of utilities, consulting engineering firms, insurance companies, trade associations, and others.

Editor's Note: Arrangements for individuals or groups to attend these programs may be made by writing E. B. Rumble, Manager, Special Hazards Department, Automatic Sprinkler Corporation of America, Youngstown 1, Ohio.

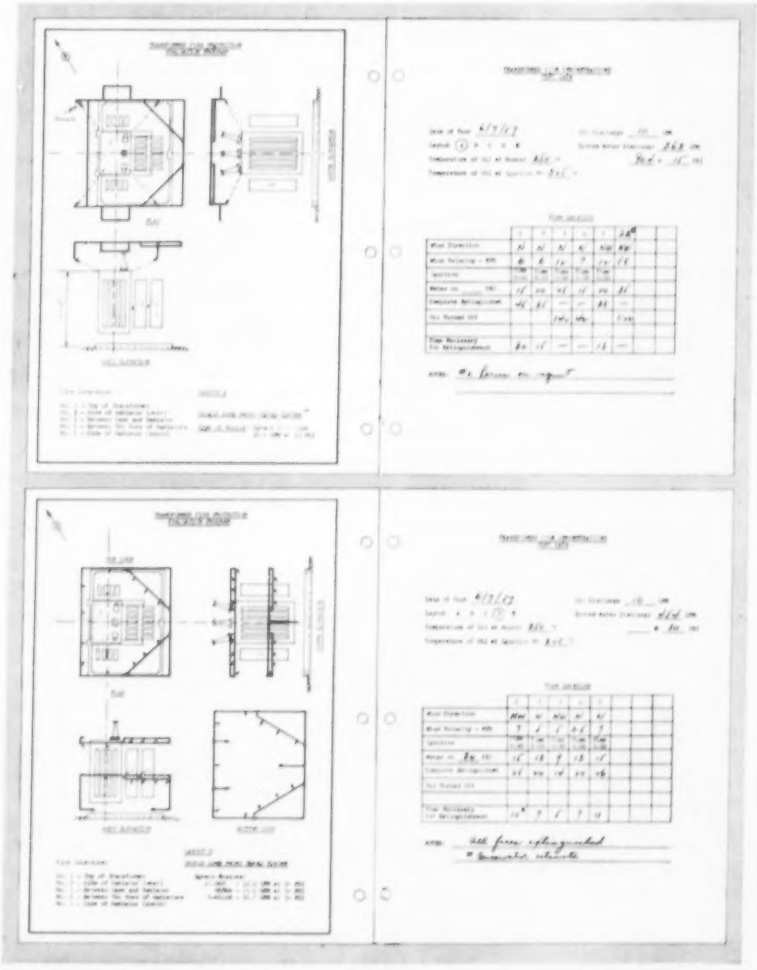


Fig. 7. Two of the evaluation test sheets filled in by observers of the test series at Automatic Sprinkler Corp. Pages at left show arrangement of nozzles and location of fire; right-hand pages are used to record data from each test

Helium Gas Turbine Nuclear Plants For High Temperature Power Cycles

ONE OF THE factors that had retarded the more rapid development of nuclear power in the United States is the comparatively low temperature at which all existing reactors have had to operate. No nuclear reactor in use or in the design stage at the present time, can operate at temperatures which will permit the generation of steam at temperatures even as high as 500 F, or steam pressures above 600 psi. The British Calder Hall Station which began operation last October and which is the largest nuclear power plant in the world, operates at a steam pressure of only 185 psi and a temperature of 575 F.

Such temperatures and pressures are very low compared to the steam temperatures and pressures used in modern fuel-fired power stations — indeed, these were the values used 25 and 30 years ago — and it is understandable that under these conditions power engineers have not been overly enthusiastic about nuclear power development. Modern high efficiency stations are designed for temperatures of 1000 and 1100 degrees and pressures of from 1000 to 5000 psi.

Nuclear engineers, of course, have been aware of these temperature limitations and for years have been striving to produce reactors which can operate at much higher temperatures. The LMFR — the liquid metal fuel reactor — for example, being studied by several working groups is an effort in this direction.

One of the most promising systems for attaining a really high temperature, high pressure nuclear power plant is a proposal by Sanderson & Porter and the American Turbine Corporation, to build a helium-cooled reactor using uranium bearing graphite pellets as fuel elements. Such a reactor would be suitable for use either with a high-temperature, high pressure steam cycle, or with a closed cycle gas turbine system. In the first case, a gas (helium) is used to transport the heat developed in the nuclear reactor to a boiler in which steam is raised and subsequently used to drive a turbo-generator set, while in the second case the gas is heated in the reactor and used directly as a thermodynamic working fluid in a gas turbine power plant.

These two systems were described in detail in a paper presented by Mr. S. T. Robinson, Chief Engineer of the American Turbine Corporation and Special Projects Engineer of Sanderson & Porter, at the Helium Symposium held at Anaheim, California, June 6 and 7. This Symposium was sponsored by Robertshaw Fulton Controls Co. Since these two power plant systems differ so widely in design philosophy and requirements, Mr. Robinson discussed them separately.

Gas Cycle for Steam Generation

The high temperature gas cycle reactor system for steam generation is, in principle, capable of raising steam suitable for use in any steam turbo-generator set built or contemplated. To meet this objective the reactor core and fuel elements are of graphite and the heat transport fluid or reactor coolant, as it is often called, is a gas. A flow diagram of the system is shown in Fig. 1. It consists of a reactor, circulating blower, heat exchanger and connecting pipe together with the necessary auxiliaries.

In operation, helium gas, at approximately 750 psi is circulated through the reactor where its temperature is raised to about 1500 F. From the reactor the gas passes to a heat exchanger in which the heat is given up to produce steam of a quality required for the turbine. After passing through the heat exchanger the gas returns to the blower inlet where the head losses of the system are made up and the cycle is repeated.

Chain-grate Stokers For Nuclear Plants?

Described here is still another type of nuclear reactor—the so-called pebble-bed reactor being developed by Sanderson & Porter together with Alco Products. Aside from its inherent simplicity, this reactor should appeal to the modern power engineer because it promises high temperature and high pressure steam conditions of the same order as used in our most advanced fossil-fuel fired plants, and thermal efficiencies perhaps even greater than those attained in our present high-efficiency plants.

The reactor consists essentially of a tube or column filled with spherical pellets of enriched uranium carbide and graphite homogeneously mixed, and cooled by helium gas at a pressure of around 750 psi, circulated by a standard type centrifugal compressor. The helium, leaving the reactor at temperatures up to 1500 F, is circulated either through a heat exchanger to make high pressure, high temperature steam or, in a second scheme, can be used directly in a closed cycle gas turbine system.

The porous balls would permit the fission products to escape into the gas stream and thus be carried off by the coolant, subsequently to be removed by traps before the helium reaches the heat exchanger or gas turbines.

As reported in the June issue of *Nucleonics*, a group of German companies are also working on the development of a reactor of this type, in fact the contract for the design of a 15 mw net (electrical) pilot plant was awarded to Brown Boveri of Mannheim and Friedrich Krupp of Essen. In the design proposed, the ball-shaped fuel elements are fed into the tower-like reactor tank from above, and unloaded below. Thus, the reactor will be controlled merely by changing the loading and the coolant flow; there will be no safety or control rods. A high rate of burnup is hoped for by re-sintering the fuel elements at intermediate intervals, thus curing radiation-damaged elements.

If this type of nuclear reactor can be made to work—and there seems to be no valid reason to believe that it cannot—it will do much to bring nuclear power costs in line with conventional plant power costs. It involves the use of no expensive, exotic metals, and fabrication of the fuel elements should be low. Based on current prices for making pure graphite, it appears that the fabrication of the critical mass for a 50-mw (heat) reactor would cost less than $10,000, indeed, it might cost as little as $1000.

The inherent simplicity of this reactor coupled with the ease of fuel element fabrication and reprocessing, to say nothing about the advantages of high temperature operation, make it extremely attractive from every standpoint. If in the long run this pebble-bed reactor should prove among the most economically feasible, it might easily develop into a type using a sort of chain grate stoker type using a chain grate to carry the pebbles through the fuel channels. It might be a good plan for the chain-grate stoker people to stay in business for a while.

A. W. Kramer
Editor

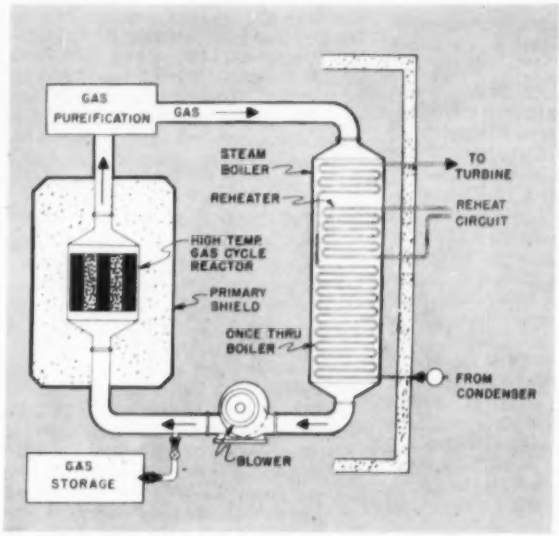


Fig. 1. Diagram of gas cycle reactor steam generating plant

1—Reactor heat output	188 MW
2—Helium weight flow	466,000 Lbs/Hr
3—System head losses	10,100 Ft
4—Net power to blower (at 80%η)	2.24 MW
5—Total energy to boiler	190.24 MW
6—Gross conversion efficiency	39.5%
7—Gross electrical output	75.18 MW
8—Blower drive efficiency	95%
9—Gross power to blower	2.35 MW
10—Other system auxiliaries	1.70 MW
11—Net electrical output	71.13 MW
12—Net efficiency	37.4%
13—Electrical output from blower power	.84 MW
14—Blower power required from system	1.51 MW
15—Pumping power/Heat transferred	1.19%
16—Blower power/Gross electrical output	3.13%
17—System blower power/Gross electrical output	2.01%

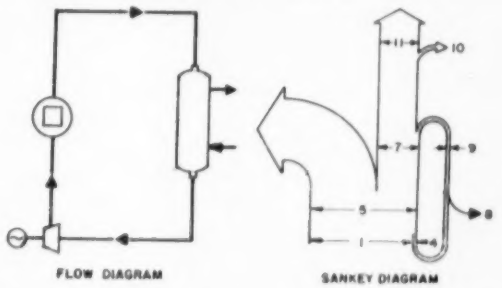


Fig. 2. Flow diagram, Sankey Diagram, and performance data on 75 mw gas cycle reactor steam plant. 1450 lb—1000 F/ 1000 F reheat, using helium cooling and motor-driven blower

The most interesting feature of this system is the design of the reactor. While Mr. Robinson did not describe the reactor design in detail, its general features are shown in the diagram. It is a graphite moderated reactor using fuel elements in the form of spheres slightly more than an inch in diameter, consisting of uranium bearing graphite matrix with an integral non-fuel bearing coating. No metal is involved in the construction of these fuel elements, hence no corrision nor structural deformation troubles can be expected. The fuel elements are contained in suitable channels in the graphite structure of the reactor and the gas passing through these channels is heated to 1500 F as already mentioned.

Helium is an inert gas and in itself does not become radioactive from nuclear bombardment. However, certain of the volatile products will be released from the fuel elements and these will become radioactive. It is necessary, therefore to shield the entire gas system including the heat exchanger itself. The system shielding is designed with the assumption that all fission products volatile below 2500 F are released to the gas stream. Actually, the release of volatile fission products will be several orders of magnitude less than this and since the direction of fuel element development will be towards virtually complete retention of fission products, the gaseous working fluid is selected on the basis that all volatile fission products are retained.

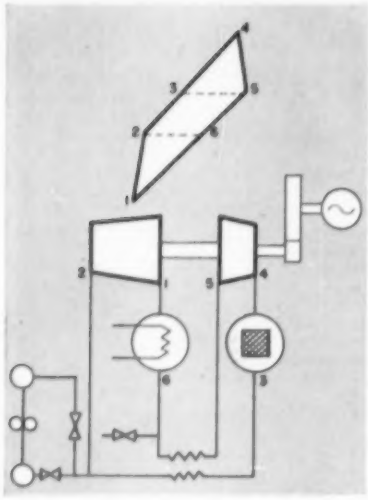
In the design of this gas-cooled system various gases were considered but all were discarded in favor of helium. The characteristics of importance in selecting a gas for a heat transport fluid in this reactor system are its chemical inertness, absorption and activation nuclear cross sections, and its pumping power modulus. Since this reactor design is based on the use of graphite as a core and fuel bearing material, the possible reaction between the gas and graphite is a major consideration. The activation resulting from irradiation in the core should be a minimum. A low absorption cross section, of course, is of importance since it reduces parasitic capture of neutrons, thereby permitting a higher conversion ratio. Absorption cross-section is also of importance since it introduces changes in reactivity with system pressure changes. Having selected a gas which is satisfactory from these standpoints, one having a low pumping power modulus, yielding a low ratio of pumping power to heat transferred, is desirable.

Referring to Table I, which summarizes the characteristics of the gases considered, carbon dioxide is discarded for this system because of its reaction with carbon above 900 F. Nitrogen presents a problem in the operation of graphite reactors at high pressures due to its high absorption cross-section as compared with graphite. If it is assumed that the graphite pores are filled with nitrogen at 750 psi, the effective cross-section would be five times that at atmospheric pressure. Thus a positive pressure coefficient of reactivity is introduced which may adversely affect reactor operating conditions. While hydrogen has excellent characteristics as a reactor heat transfer fluid its explosive range in air is between 4.1 per cent and 74.2 per cent by volume. Since a hydrogen explosion could conceivably disperse the radioactivity contained in the system, its use is thought to present unnecessary hazards. Therefore, the choice lies between neon and helium,

Table listing gas characteristics, such as chemical attack on graphite and steel

Gas	Chemical Attack On Graphite	Chemical Attack On Steel	σ_a (barns) (1)	Pumping Power Modulus ξ %(2)
Helium	None	None	0	2.6
Neon (75%Ne-25%He)	None	None	2.1	10.0
Hydrogen	None	Embrittlement	0.66	0.4
Nitrogen	None	Nitriding	3.76	5.4
Carbon Dioxide	Forms CO Above 900°C	Carburizing	0.0034	2.4

Notes:
(1) Barns per Molecule
(2) Average Value between 300 F & 1500 F



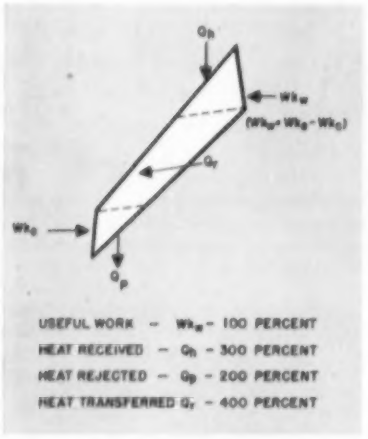


Fig. 3. HS diagram and arrangement of closed cycle gas turbine power plant

with helium being selected on the basis of its pumping power modulus.

Studies were made of a number of different power plant designs based on the use of this steam generating system, ranging from a 16.5 mw preferred standard unit having 850 psi 900 F steam conditions to a 250 mw supercritical unit having 3500 psi 1100 F 1050 F reheat steam conditions. In all cases the pumping power is approximately 1 per cent of the reactor heat or about 3 per cent of the gross electrical output. However, since all of the power expended in compressing the gas appears as heat in the boiler, and this fraction of heat is in turn converted into electricity, the actual blower power required from the system amounts to something of the order of 2 per cent of the gross output. This can be seen from Fig. 2, which is an energy balance of a 75 mw, 1450 psi, 1000 F, 1000 F reheat steam plant. Here the blower power chargeable to the system is 2.01 per cent of the gross electrical output.

All considered, the total auxiliary power requirements of a steam plant using this reactor system is about the same as the auxiliary power requirements of a coal or oil-fired plant and the net station heat rate is about 10 per cent lower due to the absence of stack losses.

Gas circulating equipment for such a reactor is commercially available in the form of the gas line blower or booster. These are single stage centrifugal machines available in a number of sizes capable of handling from 5000 to 30,000 cfm at heads up to 15,000 ft. These units, which are fully developed, are fitted with a wet contact seal on the drive shaft and leakage of gas from the drive end is impossible.

Fig. 4. Gas turbine cycle heat flow. Compressor efficiency, 33⅓ per cent

Closed Cycle Gas Turbine Plant

As already indicated, a study was also made to determine the feasibility of using this gas-cooled nuclear reactor in a closed cycle gas turbine power system. A flow diagram of a simple closed cycle gas turbine nuclear power plant is shown in Fig. 3. It consists of a gas turbine set comprising a compressor and turbine connected to an electric generator, a recuperator for the internal transfer of heat within the cycle, a sink, an off-gas system, and a nuclear reactor to provide the thermal energy which is converted to mechanical energy within the system. This is a single loop system, having no intermediate heat exchanger between the reactor and the machinery set circuit.

The study was made to determine the effect of power plant working fluid characteristics on the design of the gas turbine and associated equipment with particular reference to size. The selection of the fluid was not based on nuclear considerations though the fluids studied were known to be generally acceptable. The gases studied were helium, nitrogen, and carbon dioxide.

A plant of 5 mw electrical output and 30 per cent net efficiency was selected as the basis for this study. Design conditions for the three power plants (each using a different gas)

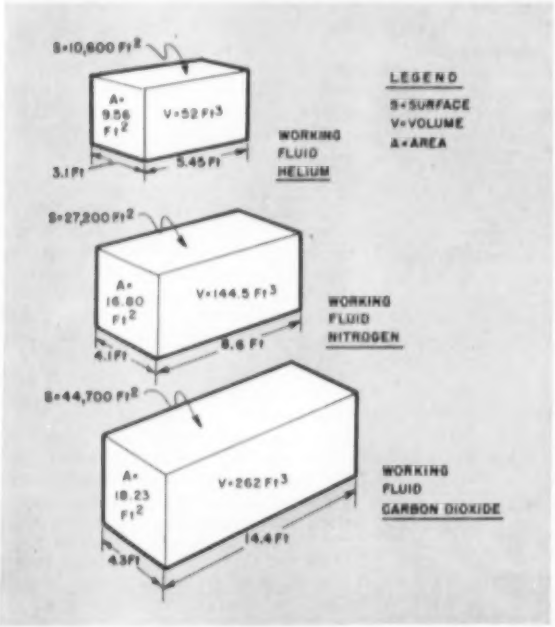


Fig. 5. Block diagrams showing recuperator requirements for a 5000-kw 30 per cent efficient closed cycle gas turbine

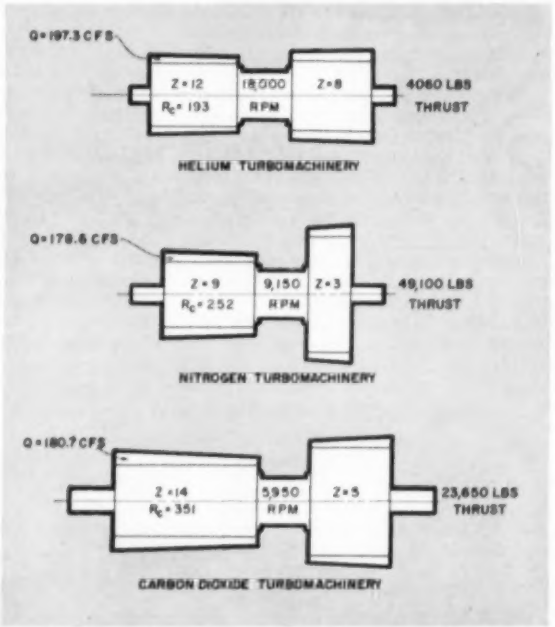


Fig. 6. Comparison of gas turbine machinery for $\Theta = 1.3$ compressor temperature ratio in a 5000-kw closed cycle

were the same. Specifically, all plants were designed for the same output and efficiency between the temperature limits of 120 F and 1300 F at a compressor temperature ratio of 1.3 with a ratio of pumping power to heat transferred of 2.85 per cent. All plants were designed for the same turbine inlet or high pressure system pressure level. In any closed cycle gas turbine plant the basis of design is the internal transfer of heat by forced convection. This occurs in the source, the sink, and the recuperator. Figure 4 is a temperature-entropy diagram of a simple closed cycle gas turbine, showing the relative magnitudes of the heat received, transferred, and rejected as a percentage of the useful work. This diagram is based on a cycle having an efficiency of 33⅓ per cent, operating between the temperature limits of 120 F and 1300 F.

Letting the heat equivalent of useful work equal 100 per cent, 300 per cent of this output is received by the cycle from the reactor on the high-pressure side of the system. After expansion through the turbine 450 per cent of the output is transferred from the low pressure to the high pressure side in a recuperator, with the low pressure design conditions controlling the surface requirements. After this internal transfer of heat in the recuperator 200 per cent of the output is rejected to air or water in a pre-cooler. The latter is shown as item 6 in Fig. 3. Thus 31.5 per cent of the total heat is transferred to the high pressure side and the remaining 68.5 per cent is transferred from the low pressure side. Therefore, any expression indicating the relative amounts of surface required resulting from the use of different gases should include a pressure term to permit evaluation on both high and low pressure sides of the system.

No attempt will be made here to present the calculations involved in the design of the recuperators but Fig. 5 shows the relative size of the units for the three different gases. On the same basis, Fig. 6 shows the relative size of the turbines, as well as the axial thrust loads. No attempt was made in the studies to reduce these thrust loads by the use of balanced areas. These were all comparative designs, using the same blading and the same type velocity diagrams.

In view of the fact that there is a complete release from Mach number effects in a helium machine while a carbon dioxide machine is badly limited in this respect, a more detailed design for a specific fluid could well result in better design. For example, highly tapered blades will result in a reduction in the centrifugal stresses in a helium machine with a possible reduction in the number of stages, while pinned root blades in a carbon dioxide machine will result in reduction in the bending loads permitting the use of something nearer to a 50 per cent reaction type

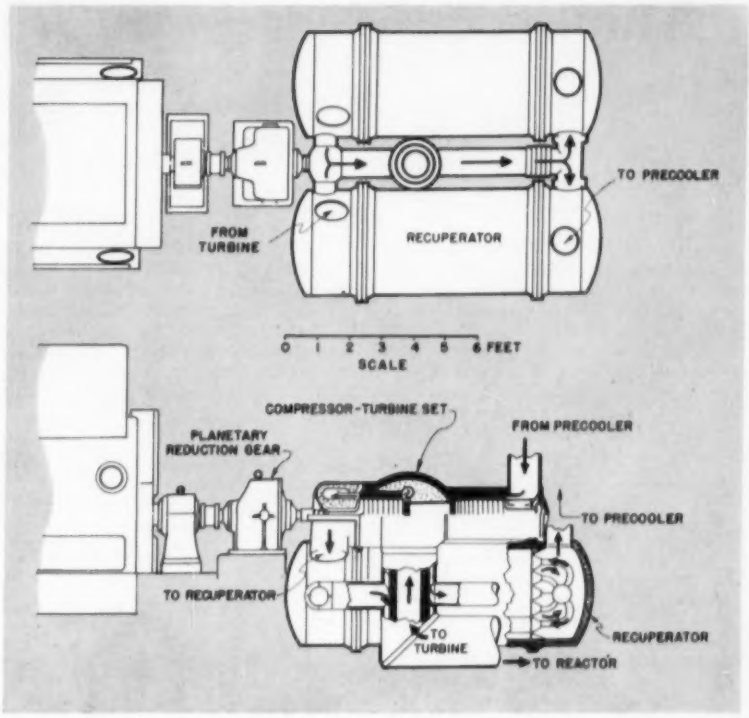


Fig. 7. Arrangement of equipment in a 5000-kw gas turbine plant using helium

design. In other words, there is no universal compressor design for all gases.

Mr. Robinson, in his presentation of his paper, said that they are doing some basic work to get a better understanding and to improve the design of helium compressors. Being speed limited by stress, a helium compressor can be run at higher speeds by tapering the blade cross section from root to tip. Within limits a high stagger angle rotor and a high degree of reaction gives a greater pressure coefficient for a fixed axial velocity through the stages. Therefore, they are looking for high reaction stages using blades with a high turning angle and taper. This work is in progress and results should be available in the near future.

The overall turbine design for these power plants is free vortex 50 per cent reaction at approximately mean diameter, which is constant for all stages. Design limitations were 100 ft per second blade speed at the mean diameter, axial velocity equivalent to that required to give the same losses as occur in a nitrogen turbine having an axial velocity of Mach 0.2 and a minimum blade height of one inch. The number of stages required for each machine was established within these limits, with the helium turbine being designed by limiting blade speed. Combined stresses in the last leaving blade row were not allowed to exceed 35,000 psi.

The results of this study are applicable to plants of greater output of the same basic design but must be used with caution for smaller plants as the flows involved may require a different type compressor, invalidating this specific comparison.

Having established the size of the recuperator and the turbine machinery the plant arrangement can be considered. In a closed cycle power plant using a working fluid other than air, which must be stored when not in circulation within the cycle, it is desirable to keep the plant inactive volume to a minimum. This requires careful attention to the ducting and those parts of the flowpath where turning takes place. Ducting is usually sized on the basis of Mach number which results in that for the helium plant being the smallest, followed by nitrogen and carbon dioxide.

Thus, in laying out the plant an attempt was made to design it with the very minimum of piping and inactive volume, and yet make it possible to reject the heat to an air or water sink. See Fig. 7.

In conclusion, the use of helium as a working fluid results in the smallest size power plant of this output and type. Development problems of the turbine machinery being the only area in question appear to be minimized due to the complete release from Mach number effects. With the development of blading specifically designed for use with helium there is every reason to believe that the design of a turbine could be approached with the same degree of assurance that would be had using air as the working medium.

Think You Need More Air Compressors?

Here's a formula for finding a realistic--and economical--answer

By H. B. WAYNE

FIRST OF ALL inspect the piping system for possible air leakage. This means all pipe, fittings, valves and flexible hose. Leaky joints, poorly seated and open valves, as well as cracked hose, are common causes of air loss. Since leakage of air is not readily detected, it may be necessary to install pressure gages temporarily in various parts of the system to determine location of leaks. Figure 1 shows an arrangement for performing this test. By installing tee fittings as shown, it is possible to perform this operation with two pressure gages which can be removed when the test is completed. The tees are provided with root valves to prevent air loss after the test is completed.

Secondly, take card readings for compressor cylinders. Also measure air delivery rate and pressure at outlet of each machine and compare with design values. For this purpose, an orifice assembly may be used for flow measurement and need not have the refinements available with a flow nozzle or tube as sometimes employed when testing in accord with the ASME power test code. If card readings and/or observed flow rates are less than originally specified, check prime mover performance for power consumption.

Third, with electric motor drives, voltage and current readings will determine if the motor is drawing rated power. Indicator cards will give similar information for direct acting steam-driven machines and for internal combustion-driven units. If these values agree with design, prime mover is performing satisfactorily. Next, inspect compressor valves and running gear. Dirty and poorly seated valves, worn piston rings and cylinders are frequent causes of failure for compressors to deliver rated air quantities. If pneumatic or electric unloading is employed, inspect for valve position during each step.

Fourth, check temperature of water entering and leaving inter- and after-coolers. Frequently, cooling water supply is inadequate, causing reduced compressor output because of high temperature air entering the high pressure cylinder. This may be caused by pump not delivering required flow rate, partial or complete closing of valves in the water circuit, fouling of cooler tubes due to scale formation and/or dirt accumulation.

Fifth, measure air consumption of equipment being served. Poor mechanical condition of pneumatically operated tools and other air-using facilities will require quantities in excess of design values. If this condition prevails, inspect, repair or replace accordingly. Approximate air consumption of tools and other equipment may be determined from the following relations:

$$V = K \times P$$

where;

V = Air flow rate—cfm.
K = A constant from Table A.
P = Pressure gage reading—psig.

TABLE A

Pipe Size Inches	K	Pipe Size Inches	K
⅛	0.95	1¼	25.0
¼	1.74	1½	34.0
⅜	3.20	2	55.0
½	5.09	2½	80.0
¾	8.90	3	122.0
1	14.30		

Location of the pressure gage for performing the test is shown in Fig. 2.

Sixth, compare location of air-using equipment with respect to the compressors. Frequently, distance between receivers and load exceeds that originally planned, which will limit air flow. This condition is common when a plant is expanded some distance from the air source.

By locating additional receivers at or near the load, it is possible to minimize pressure loss and maintain required air delivery rates. Figure 3 shows details for these relations. With receiver(s) located at the compressors only, maximum pressure loss occurs as indicated by A. Installation of a receiver near the load, limits losses, thereby permitting more air to be delivered as shown in B. When pressure in receiver No. 1 drops to a set value or limit, the back pressure valve opens, permitting air flow from the No. 2 receiver. For many applications, demand for air in excess of that available from the No. 1 receiver is infrequent and of short duration, which allows operating most of the time with minimum pressure loss.

Seventh, sometimes demand for compressed air in excess of plant capability exists for short periods of time and at infrequent intervals. It is possible to avoid installing additional large units, by locating a small portable compressor in the area where this condition prevails. Figure 4 shows details. This arrangement permits placing the unit where the peak load exists. The installation may be made in short time without special tools and skilled personnel.

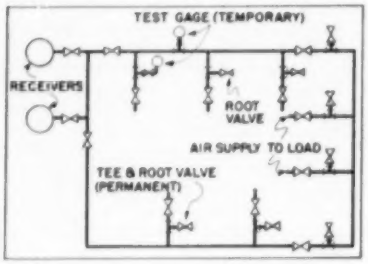


Fig. 1. Arrangement for testing piping for air leakage, with pressure gages

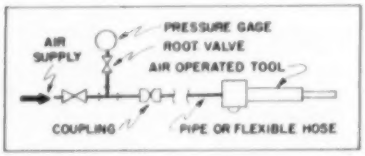


Fig. 2. Location of pressure gage in measuring air consumption of equipment being served. Is tool in good shape?

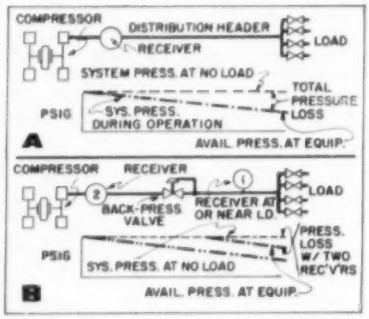


Fig. 3. Locating additional receivers at or near load minimizes pressure loss. B shows scheme A with receiver added

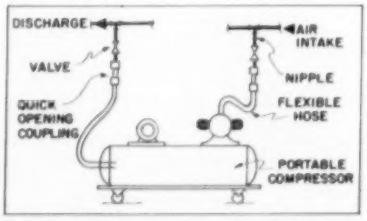


Fig. 4. Sometimes a small portable compressor placed where peak load exists will be an economical answer to problem

Fig. 1. Aluminum jacketing on the new steam pipeline between Esso's Bayway refinery and Linden station of Public Service Elec. & Gas Co in New Jersey protects heat-saving insulation on the 5½-miles of pipe from weather effects

Aluminum Jackets Linden-Bayway Lines In Steam-Oil Swap

Big steam lines linking Esso refinery, Linden generating station are insulated and jacketed with aluminum to save $500,000 a year

NEW steam-carrying pipeline system that is protected from rain, snow, dirt and ice by a gleaming, corrosion-resistant aluminum jacket, now is in operation at Esso Standard Oil Co's Bayway refinery.

The aluminum application, one of the largest of its type, employs 80,000 lb of alloy 3003 sheet produced by Aluminum Company of America. It shields 5½ miles of large diameter, insulated steel pipe from damaging weather and a corrosive industrial-marine atmosphere.

According to Esso, insulating and jacketing the lines has cut heat loss to only 5 per cent of that experienced with bare pipe. An expenditure of more than $500,000 would be required annually to replace the heat that would escape if the pipelines were not insulated and protected.

Designed by engineers from Esso and several consulting firms, the new pipelines link refinery facilities and the recently completed Linden generating station of the Public Service Electric and Gas Co. Nearly all steam required in the refinery's processing operations now is supplied by the station through two 30-in. low-pressure lines and one high-pressure 20-in. line.

Steam at 462 F flows through the 30-in. pipes to the distributing system in the process area. In the high-pressure line, steam enters at 740 F and passes to the refinery's distribution grid at the central boiler house. To conserve heat and maintain steam efficiency, each new pipeline is wrapped in mineral wool insulation manufactured by Baldwin-Hill Co, and jacketed with Alcoa aluminum.

In addition to the process steam pipelines, a 16-in. low-pressure line delivers steam to the refinery's waterfront area, and two 8-in. steam-traced lines carry fuel oil to the power station. To keep the oil flowing, these lines also have been insulated to lock heat in, and jacketed to keep weather out.

In performing the big insulating job, the Trybee Co, Inc., first wrapped the lines with the blanket-type insulation, then added a layer of 15-lb roofing felt. Aluminum sheet in alloy 3003 was cut to size, shaped, and punched prior to reaching the job site. When installed, the easily handled sections were drawn tightly around the felt-covered insulation, and secured with self-tapping screws. Complete weatherproofing was insured by the careful overlapping of adjacent sheets.

At elbows and fittings in the pipelines, mineral wool insulating-finishing cement and asphaltic mastic weatherproofing compound were used in place of aluminum sheet. These sections were coated with aluminum paint to preserve the neat appearance afforded the new pipeline system by the bright metal jacketing.

Fig. 2. Insulation wrapped around pipes was covered with a 15-lb roofing felt

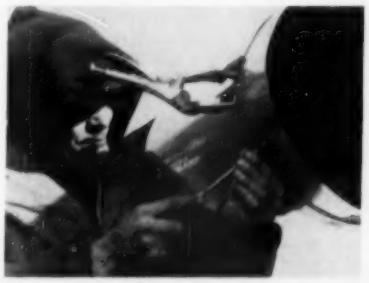
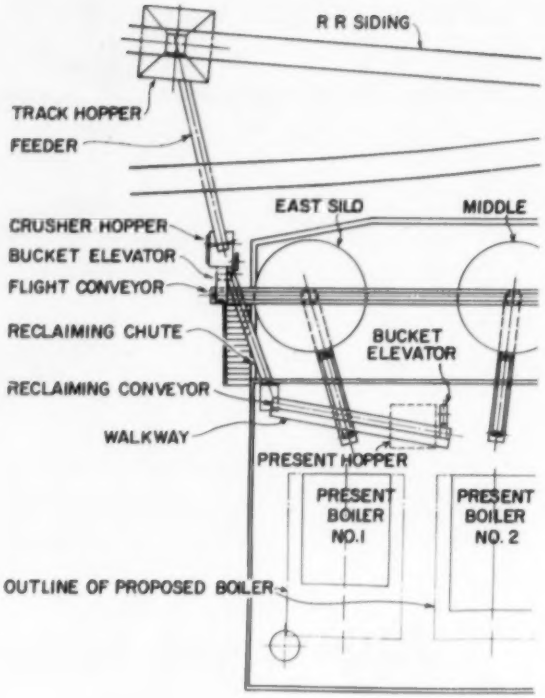


Fig. 3. The final covering is aluminum sheet, secured by self-tapping screws

Fig. 1. Boiler house for Plant D, as seen from river. Above firing floor window sill, siding is corrugated asbestos



Plant D is the fourth of six cases presenting actual costs of modernizing small industrial power plants

What It Costs

THIS INSTALLATION, rather than being a replacement of existing boilers, was an addition to an existing plant required by expanding business and an increase in steam requirements.

The manufacturing plant served makes paper board and folding boxes. It is located in a former cotton mill, the oldest buildings, some of which are still in use, dating back to 1837. The original mill was located to take advantage of a water power on the Patapsco River and as a result occupies a very cramped site in one of the narrower parts of its valley.

During an earlier expansion of the paper board mill the boiler plant had been relocated on the opposite side of the river from the mill proper and equipped with two second-hand boilers and multiple retort underfeed stokers. The boilers were B&W sinuous header longitudinal drum-type, of 604 and 693 hp rating, but due to the antiquated design and insufficient grate area of the stokers it was difficult to maintain a continuous output of more than about 50,000 lb per hour of steam and they required a premium grade of coal with a high ash fusion temperature.

Fig. 4. Plant and silos from railroad

When the boiler house was moved across the river a trapezoidal area upstream of the boiler house proper was enclosed in the river wall for use as a coal storage but it proved inconvenient and its use was abandoned. It had however an excellent river wall going down to bed rock.

A study of the possibilities of the paper board mill site indicated that unless there were entirely unforeseen developments in the paper board industry, the probable ultimate steam requirements of the operations which could be conducted in the area available would not exceed 120,000 lb per hour. This was not all needed at once, and as the B&W boilers in use were built in 1916 and 1922 respectively and would have to be replaced in the not too distant future, a logical arrangement would be to install one 60,000 lb per hour boiler now and similar ones when the replacements of the other boilers took place, providing eventually a modern plant for 120,000 lb of steam per hour with a spare boiler. While space was limited, as can be seen from the drawings and photographs, the working room and accessibility in the boiler house have been found satisfactory.

Auxiliary equipment, that is, feedwater heater boiler feed pumps and coal handling, were designed for the ultimate capacity of 120,000 lb per hour.

The general plan is shown in Fig. 2 and a vertical section through the new boiler, No. 3, is shown in Fig. 3 and outside views of the completed plant in Figs. 1 and 4.

An economic study showed that, with the rather low rates for electric power available in that area, it would tie up a large sum of money on a no better than break-even proposition to install electric generating equip-

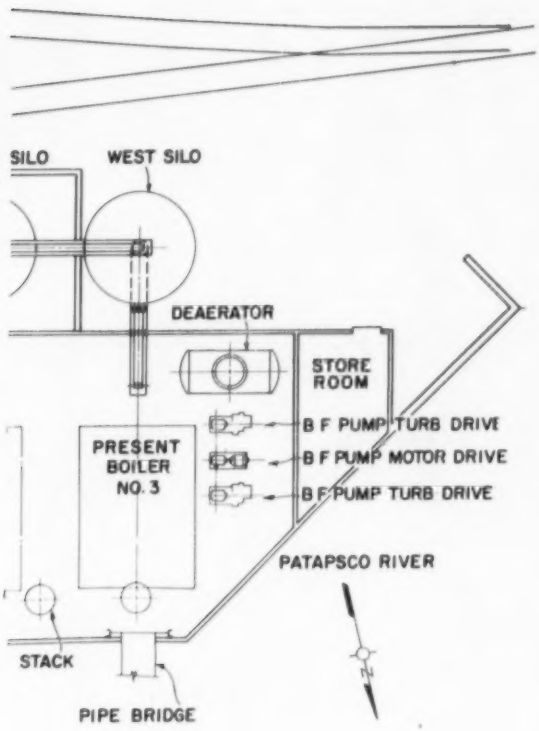
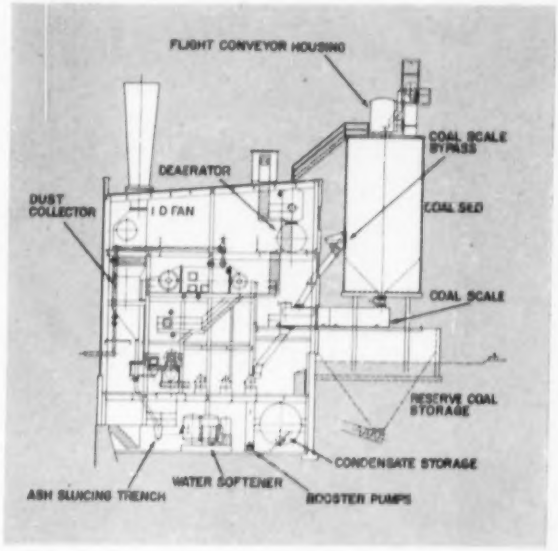


Fig. 2. General plan of boiler plant. One new 60,000 lb per hr boiler, No. 3, was added. Space was tight but adequate

Fig. 3. Transverse section through No. 3 boiler. 3-drum, bent-tube unit has water tubes on furnace side walls only



To Modernize

By H. D. FISHER*

ment; so the steam conditions were set at 190 psig 100 F superheat, the same as the existing boilers.

High volatile coal with low ash fusing temperature is available at advantageous prices in this area due to low prices at the mines and short rail haul, so all circumstances favored the choice of a spreader stoker. This, however, introduced another problem, that of supplying two different grades of coal. As Bituminous Coal Research, Inc has seen fit to comment favorably on the installation both as to functioning and cost, we feel that a fairly complete description of the coal handling equipment can be included.

The coal handling arrangement for the two old boilers consisted of a concrete hopper along the front of the boiler house, shown in outline as reserve coal storage in Fig. 3. Coal was unloaded from cars into this by a portable flat belt conveyor over the tracks under the coal car hoppers, and an inclined belt-type loader elevating the coal into the concrete hopper. The side track was close enough to the hopper to permit this to be done. An inclined screw conveyor raised the coal from the bottom of the concrete hopper to the foot of the bucket elevator shown inside the boiler house in Fig. 2. This bucket elevator dumped into the dotted hopper marked "present hopper," from which pipe chutes carried the coal to the stoker hoppers of boilers No. 1 and 2.

This arrangement required an excessive amount of labor at the conveyors, and as the concrete hopper was uncovered, the rain and snow gave endless trouble inside the boiler house, with wet coal hanging up in bin and chutes and rusting out the equipment. It has been described in some detail, however, as some of it was incorporated in the new coal handling system.

In the new system a track hopper was installed at a point on the outer side track which allowed room for unloading four cars of coal at each switch with a car puller to move the cars to the track hopper. A long, pan-type feeder delivers the coal to a two-roll crusher, with by-pass, which in turn discharges into a slow speed pivoted bucket elevator. This elevator in turn discharges into a flight conveyor which passes across the top of the silos and is gated to discharge into them individually as required. Capacity of this equipment is 50 tons per hour. Fig. 9 shows this in part, also a portable car shaker which has proved a great labor saver.

As will be noted in Fig. 2 the silo location is unsymmetrical. The foundation structure was designed to support four silos and the space between the middle and last silos made large enough to accommodate a fourth silo of the same size when and if it is needed.

Meantime a chute visible in Fig. 9 allows coal to be transferred directly to the reserve storage. The silos can also be dumped directly into the reserve storage, which has been fully roofed and enclosed. Transferring coal from the reserve storage to any of the silos is a process of raising it by the old bucket elevator onto the reclaiming conveyor shown in Fig. 2, carrying it by the reclaiming chute to the foot of the new bucket elevator and delivering it by the flight conveyor as required. Each of the silos holds about 140 tons, enough for 48 hours or more steaming; the re-

*Consulting engineer, Westcott & Mapes, Inc., New Haven, Conn.

serve storage, approximately 300 tons.

Coal scales with extended belts transfer the coal from the bottom of the silos into non-segregating chutes above the stoker hoppers.

With so much light, fine, dry ash, partly from the cinder catcher, and plenty of river water available, sluicing seemed the desirable method of ash disposal. Fortunately there was a narrow strip of low river bank down stream from the boiler house. Ordinarily this would have inadequate area but drainage was speeded by ditches two feet deep and six feet

Fig. 5. Ash sluicing basin and cribwork. This drain system has worked very well

Fig. 6. Induced draft fan is located over dust collector, just under roof

Fig. 7. View of stoker for No. 3 boiler and part of non-segregating chute. It has three feeders and through grates

Fig. 8. Boiler feed pumps and boiler control board. Two of the pumps are steam turbine driven and one is motor driven

apart. These were dug transversely, drain tile laid in them and covered with about a foot of crushed stone, and the remainder of the ditches covered with gravel. The area was enclosed by a crib of creosoted ties filled with stone and gravel along the river edge, and the far end left banked with about two feet of ash when the storage is emptied.

The drain system has worked very well as the water drains off quickly and effluent from the tile is clear. Periodically the refuse is pushed out by a bulldozer, care being taken not to get too deep, and sold for cinder blocks. A view of the sluicing basin and cribwork is shown in Fig. 5. Interestingly enough, this cribwork has been completely submerged several times in flash floods without damage except washing out some of the gravel fill.

The stoker and part of the non-segregating chute, also the end of the control board cubicle, are shown in Fig. 7. It has three feeders and through grate sections. Grate overall is 12 ft 6 in. wide by 13 ft 7 in. long. Fly ash is re-injected from the boiler passes. Re-injection from the dust collector has been abandoned because of excessive ash loading of the gases and polishing of the boiler tubes. The boiler is of the three-drum bent-tube type with spaced-out water tubes on

Fig. 9. Coal handling equipment. Chute delivers the coal directly to storage silos. Portable car shaker in foreground has proved to be a great labor saver

the furnace side walls only. Boiler tube heating surface is 8584 sq ft; water wall tube surface, 562 sq ft in 3¼ in. tubes set tangent to the refractory wall on 9⅝ in. centers. An intertube superheater for 100 F superheat consists of 487 sq ft in 1½ in. tubes.

Design capacity is 60,000 lb per hour continuous, 75,000 lb per hour for 4 hours, steam at 190 psig 100 F superheat with feed at 230 F; but on occasion it has averaged 80,000 lb per hour for 24 hours without distress.

Forced and induced draft fans are duplex driven with steam turbines and motors. The forced draft fan is below the firing floor in front of the boiler; the induced draft fan over the dust collector just under the roof. The latter is shown in Fig. 6. A dust collector is installed just under the induced draft fan which discharges through a venturi stack.

Combustion control is of the electrically operated metering type (the control board for No. 3 boiler only is seen in the background of Fig. 8). Coal feed is adjusted to load requirements, forced draft from coal feed subject to manual adjustment of the fuel air ratio and induced draft from furnace pressure. Control is by dampers in the outlet duct of the forced draft fan and inlet ducts of the induced draft fan. The board also carries draft gages, damper position indicators for manual control, fan motor ammeters, pressure gages for boiler and main line steam and

COST OF EXPANDING PLANT D—1948–49

Boiler and Accessories	Bigelow Co	$130,390
Boiler	Bigelow Co	
Setting	Geo. Allen & Son	
Stoker	Detroit Stoker Co	
Steam turbines	Westinghouse Elec. Corp	
Motors	General Electric Co	
Forced draft fan	American Blower Co	
Induced draft fan and stack	Prat Daniel Corp	
Dust collector	Prat Daniel Corp	
Coal and Ash Handling	Robinson-Branin Co	76,825
Coal silos	Neff & Fry Co	
Auxiliaries		
Water softening equipment	Permutit Co	7,341
Combustion control	Leeds & Northrup Co	4,051
Control board	Leeds & Northrup Co	4,184
Instruments, etc.	Leeds & Northrup and others	3,499
Condensate storage tank	Norwalk Tank Co	8,000
Deaerating feedwater heater	Elliott Co	10,665
Rigging heater into place		475
3 Boiler feed pumps	Ingersoll Rand Co	5,155
2 Condensate pumps (in paper board mill)	Ingersoll Rand Co	1,788
3 Booster pumps	Ingersoll Rand Co	1,828
2 Ash sluicing pumps	Ingersoll Rand Co	1,862
Stationary vacuum cleaner	S. L. Cooke Co	2,513
Piping and valves	J. W. Marchant	46,590
Thermal insulation	Ried Hayden, Inc	2,782
Electrical load center	Westinghouse Elec. Corp	7,635
Rigging center into place		106
Electric wiring	Brown & Heim, Inc.	6,621
Foundations	Smith De Corse and Christhilf	71,367
Superstructure except steel	Smith De Corse and Christhilf	66,317
Superstructure steel frame	Maryland Steel Product Co	17,776
Bridge for pipes and walkway	Maryland Steel Product Co	13,526
Engineering	Westcott and Mapes, Inc	51,300
Field Supervision	Westcott and Mapes, Inc	1,531
Total Actual Cost		$544,127

Due to an unusual combination of unfavorable circumstances the cost of this project exceeded the estimate by about 20 per cent. Among the major items causing delays and additional expense were:

(a) Holding up by owner of engineering work when design was about half completed.

(b) Strike of iron workers in that district when building frame was partially completed, delaying construction about three months.

(c) Extra expense for enclosing building and heating because (b) threw building and boiler completion into the winter season.

(d) Lower productivity of construction workers in cold weather.

(e) Erroneous information on foundation conditions supplied by owner's representative.

(f) Field supervision by owner's engineer resulted in lack of complete control of project by consultants.

Because of provisions for future expansion in coal handling and feedwater systems, a figure for cost per lb of steaming capacity per hr is rather meaningless.

feedwater line, water level indicators for boiler, heater storage tank and condensate storage tank, boiler steam floor meter and feed line water meter.

Feedwater is somewhat of a problem, for though the Patapsco water only averages about 40 ppm calcium as $CaCo_3$, makeup has run about 50 per cent. An automatic zeolite softener was therefore installed, the softened water being fed under manual control into the condensate storage tank which holds 15,000 gal. It is welded of stainless steel clad plate.

The deaerating feedwater heater is of 120,000 lb per hour capacity with 15-min storage and was installed just under the roof. Condensate from the paper board mill is pumped directly into the heater and makeup supplied by booster pumps from the condensate storage tank in the basement. There are three of these pumps, one running, one ready to start from a float switch in the heater storage tank on low water load, and one a spare. Overflow from the heater returns to the condensate storage tank.

There are three boiler feed pumps of full capacity, two steam turbine-driven and one motor driven. These are shown in Fig. 8.

The building above the firing floor window sill level is sheathed in corrugated asbestos siding with butt joints and presents, as can be seen from Fig. 1, a neat well-finished appearance. There is no wall insulation and as the boiler radiation is rather low, several unit heaters were installed. The roof is five-ply tarred felt on precast concrete slabs.

The support for the steam and water lines connecting the boiler plant and mill had been a rather elastic suspension bridge which subjected the pipes to considerable bending and vibration. This was replaced with a rigid truss bridge and walkway, the boiler house end of which can be seen in Fig. 1. An unexpected bonus from this bridge was received when, a few years after it was built, the state highway bridge about 200 yds downstream, which had been the regular thoroughfare between the mill and the boiler house and rail siding, collapsed. This left vehicle connection with the freight siding subject to a four-mile detour and would have been rather inconvenient for pedestrians except for this foot bridge.

Reduced Operating Costs?

Whatever the cause of a plant remodeling, there is always considerable pressure by the owner to have the new equipment reduce operating costs at least enough to equal the fixed charges on the expenditure required.

In the plants described in this series of articles, full data on operating costs before and after the change were available to the writer only in this present case — Plant D. In this case, in spite of several increases in wage rates, the reduction in operating expenses for years of equal factory output exceeded the fixed charges, including 5 per cent interest on the new expenditure, by about $10,000 per year.

At Plant A, described in the first article of this series (POWER ENGINEERING, May 1957, pp. 82–84), no separate account was maintained for boiler house expense, but the management stated that, although a new building had been added at about the same time, the fuel consumption remained about the same and there was a reduction from two operators to one per shift.

Plant B, described in the June 1957 issue of POWER ENGINEERING, pp. 92–94, was operated for only a short time on a load comparable with that on the coal-fired plant, as business conditions forced the closing of the section of the factory. The owner stated, however, that for this period the fuel savings were very large, particularly in coal used for banking boilers on the night shift. There was a considerable reduction in labor, three firemen and a coal passer on the day shift to one fireman.

At Plant C (POWER ENGINEERING, July 1957, pp. 49–50) a large Corliss engine was shut down during the installation of the new boilers so that the change in load makes an intelligent comparison of costs before and after the change impossible. It did result in a reduction of labor, from two to one man per shift.

Plant E, to be described in the next article in this series, was very well operated before the installation of the new boiler, and while it seems likely that the forced draft register-type burners of the new boilers, with automatic combustion control, are more efficient than the flat flame steam atomized burners in the clinker bottom furnaces of the old boilers with manual draft control, the oil meter records are so erratic from day to day that they appear completely undependable. No change was made in attendance.

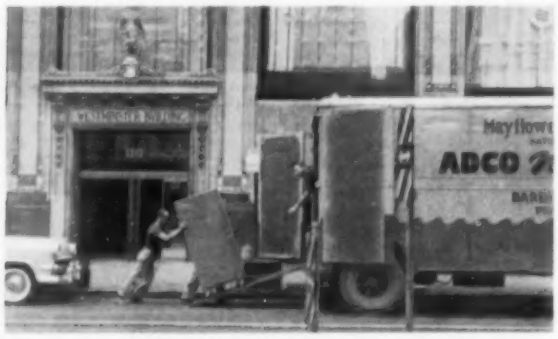
From There . . . . . .

POWER ENGINEERING'S

Hottest news this month . . at least to your editors . . is the magazine's move to a new home in the country. Here's the story . . . . . .

Now that we look back on the Big Move, maybe it wasn't so bad after all. But at the time, we wondered if this issue would ever get to the printer. Pictures — some of them spoofed-up a bit — prove that we made it. At any rate, POWER ENGINEERING'S efficient new home in the suburban community of Barrington, Ill., is well worth the trouble

Old Quarters in Westminster Bldg., Chicago, at busy corner of Dearborn and Monroe Streets became inadequate for growing staff and editorial operations



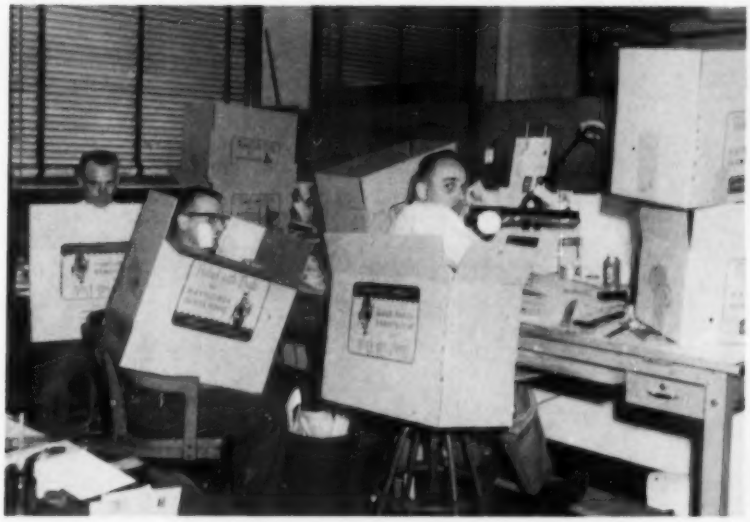
Move to Own Building in Barrington, about 30 miles northwest of Chicago, was planned about three years ago. Here goes last of editorial desks into one of the vans

Getting Out the Issue, Welden Reynolds refuses to be distracted by furniture-tagging operation carried on by Chuck Maxwell; in background, Virginia Martini seeks right word, oblivious of boxes perched precariously over her head. Executive Editor Earle (*center*) selects books to save; Editor Kramer (*right*) ignores the whole mess

. . . . To Here

NEWS REEL

Still Under Construction when picture was taken, here is the new home of Technical Publishing Company



Well, Art Department Thought It Funny, so who are we to call it a corny stunt? Here's Art Director Jim Wilcox (*center*), Bob Koster (*left*), Dick Trefilek (*right*) boxed-up and ready to go; tag on Jim's glasses is "artistic" touch

Publisher Kingsley Rice does his part — he thinks — by carrying out a pair of lightweight personal files

It's Almost All Over as last desks get wheeled out of old office, home of POWER ENGINEERING and its companion publication, *Plant Engineering*, since 1950

Overlooked by Movers, waste basket and extension cord are "salvaged" by Treasurer Art Rice and Richard Randau, last to leave. (*Ed. Note:* Who took the picture?)

POWER ENGINEERING'S Big Move continues (see preceding pages). Vans line up for unloading at new building, 308 East James Street in Barrington

. . . And Here We Are

Look What We Walked Into! Material delays, short shipments prevented completion of editorial offices on time. Moral: If in frying pan, don't jump 'till fire out

The Photographer Swears this picture wasn't posed but somehow we doubt him. Virginia Martini, under the ladder, claims she was too busy to notice anything. Ha!

Strong, Horizontal Lines of new building express progressive, modern spirit — just what we try to put into the magazine. Mover in foreground is modern, too.

Unperturbed by First-Day Confusion, Associate Editors Reynolds and McCaw use available furniture to catch up on work. (And where are those beautiful drapes?)

The Station Wagon Set: Some staff members will commute from various suburbs of Barrington — Chicago, for example. Company provides two wagons for commuters

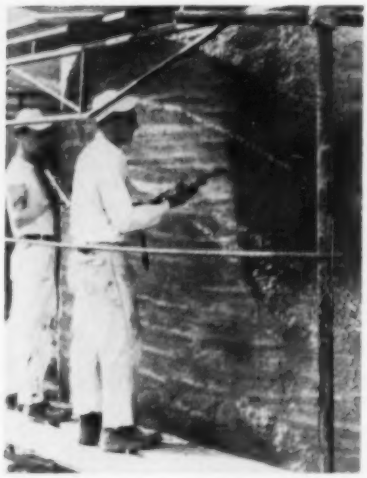


Fig. 1. Perlite concrete goes on fast with spray gun. It adheres readily to paper-backed wire lath on framework

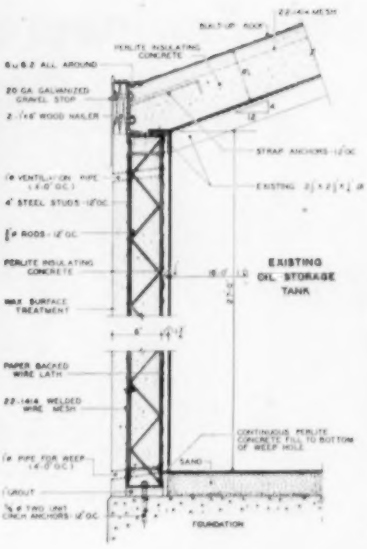


Fig. 2. Cross-section of one of U. S. Gypsum's perlite-treated fuel tanks. Framework is attached top and bottom

Fig. 3. Finished tanks are enclosed in 6-in. perlite barrier making them fireproof, weatherproof, easy to maintain

How To Fireproof Your Fuel Tanks

. . . and insulate them at the same time

NEW TECHNIQUE has been developed for protecting gasoline and oil storage tanks from the dangers of fire and evaporation loss by protecting them with perlite insulating concrete.

United States Gypsum Co recently used the new method on three medium-size fuel tanks at its Philadelphia plant. In this case, the company wanted to enlarge one of its buildings that was very close to the 50,000-gal fuel tanks, but was unable to do so because of municipal fire regulations. Approval was granted, however, after the tanks had been fireproofed with concrete made with perlite — an expanded volcanic mineral that can replace ten-times-heavier sand in gypsum plaster and insulating concrete.

At the same time, the perlite concrete serves as an effective insulator to minimize evaporation loss. In many instances, and with fixed-top storage tanks in particular, heat input through the tank shell and other causes of vaporization permit profits to boil out into the atmosphere.

Additionally, the perlite concrete protects the metal tanks from rust and weather and is rot and vermin proof. As a result, annual tank maintenance costs are slashed. Furthermore, the white perlite concrete creates a pleasing, textured, monolithic surface that is easy to maintain.

Application of a six-inch thickness of perlite concrete around the tanks (18-ft diameter by 27 ft high) was simple, efficient and economical. It was machine-sprayed onto a paper-backed wire lath which had been attached to a Trussteel stud framework around the tanks (Figs. 1 and 2).

This framework was connected only at the top of each tank and to runners circling the base. Thus the perlite concrete protection was built structurally independent from the metal tank exterior so as to provide a 1¾-in. dead air space. The insulating property of the perlite concrete barrier together with the dead air space is calculated as having a U value of 0.16. (U equals the heat transmission in Btu per hour, per square foot, per degree F of temperature difference from air to air of a given building section.) This highly satisfactory insulation value is equivalent to that provided by more than three feet of structural concrete.

When completed, the perlite concrete was waterproofed. Tank tops were also protected with perlite concrete and then covered with four-ply membrane gravel roofs.

The composition of the concrete mix was as follows: 4 cu ft of perlite to one bag of Portland cement, 5 lb of Lumnite cement, 3 oz of NVX air entraining agent (vinsol resin solution) and 62–64 lb of water.

Perlite concrete sprayed walls of this construction are approved for 4-hour retardant ratings. They may be applied by any experienced lathing and plastering contractor equipped with spraying equipment.

According to the plastering contractor on this project, Venzie Corp, concrete made with lightweight perlite aggregate was specified for fireproofing and insulation because of perlite's versatility and economy. Perlite, a volcanic rock that has been "popped" under heat like popcorn, is comprised of white, noncombustible cellular particles whose myriad tiny sealed air cells make it an excellent insulator.

The fire-retardant quality of perlite concrete is due in part, it is claimed, to the fact that perlite concrete when exposed to fire releases chemically-combined water in the form of vapor. This action limits the temperature to 212 F until all the water has been driven off. Additionally, concrete made with perlite instead of heavy aggregate enjoys limited expansion at high temperatures. Consequently, there is a minimum of cracking upon exposure to flames, preventing fire from penetrating the concrete barrier.

It is stated that building code authorities have been quick to recognize the official fire ratings on perlite insulating concrete obtained from nationally-known testing laboratories and to grant perlite concrete immediate acceptance as an approved fireproofing material.

For additional details on this product and its uses, write the Editor, POWER ENGINEERING, 308 E. James St., Barrington, Ill. Or jot Perlite Concrete on the prepaid return post card elsewhere in this issue.

Big Job-Engineered Heat Pumps Make the Big Savings

Fig. 1. Equitable Savings & Loan Building in Portland, Oregon

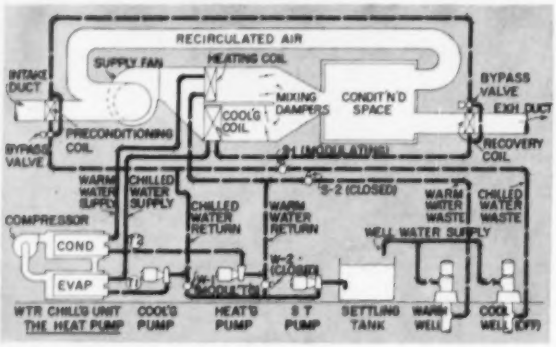


Fig. 2. Flow diagram of Equitable's heating-cooling system with valves positioned for flow when heating load is greater

TOTAL COSTS * OF AIR CONDITIONING THE EQUITABLE BUILDING
(From April 30, 1952 to May 1, 1953)

ITEM	DESCRIPTION	HEATING DOLLARS	COOLING DOLLARS	TOTAL DOLLARS	TOTAL PERCENT
1.	Heating Energy	773.63	—	773.63	4.6
2.	Cooling Energy	—	5,702.32	5,702.32	33.9
3.	Fan Energy	161.50	1,961.64	2,123.14	12.6
4.	Operators' Salaries	1,790.00**	5,370.00	7,160.00	42.5
5.	Maintenance & Repair	136.00**	544.00	680.00	4.0
6.	Water Treatment	400.00	—	400.00	2.4
7.	Total	3,261.13	13,577.96	16,839.09	100.0
8.	Total per NRA***	0.022	0.091	0.113	

* Does not include amortization of first costs.
** Breakdown as estimated by chief operating engineer.
*** Cost per year per square foot of Net Rentable Area.

Table showing operation cost study for Equitable's heat pumps

GREAT STRIDES have been made in recent years in the development and promotion of smaller heat pump units, especially for residential dwelling use. But comparatively little publicity has been given the big "work-horse" installations which are winning sizable savings in operating costs over conventional heating-cooling methods.

Take for example the beautiful 12-story Equitable Savings and Loan Building in Portland, Oregon (Fig. 1). Here a 540-ton Trane heat pump provides heating and cooling to a building of 2,275,000 cu ft and over 36,000 sq ft of glass area — and at a total cost considerably under conventional methods.

The Equitable story is a significant one, since an accurate breakdown of cost was kept for a full year of operation. This cost analysis (see table) appears to have completely vindicated the judgment of the owners and the engineers (J. Donald Kroeker & Associates) in the selection of a heat pump system. Costs show that both heating and cooling have run less than for comparable buildings in the same city. True, the capital investment in heat pump equipment was greater than it would have been for conventional heating-cooling units, but the long-time savings will more than justify the increased first cost of installation.

Based on Portland's low power rate of 3.3 mills per kwh and a demand charge of $1.10 per kw, the Equitable heating cost averaged 2.1 cents per sq ft, and the cooling cost 9.2 cents per sq ft. Comparable buildings in Portland for the same period averaged 7.74 cents per sq ft for heating, and the Equitable cooling cost can be compared to 16.9 cents for the average U. S. office building.

The Equitable Building uses well water, from different strata, and thereby obtains cool water (at 57 F) and warm water (at 65 F). The heat pump equipment consists of the following: 1. four centrifugal water-chilling compressor units; 2. two warm wells and pumps; 3. one cool well and pump; 4. a water settling tank and pump; 5. cool water circulating pump; 6. warm water circulating pump; 7. supply fan, heating and cooling coils, plenums, preconditioning coils, ductwork, valves and piping. A simplified diagram of this equipment is shown in Fig. 2.

This system is completely automatic, except that the entire start or stop operation is done manually. An interesting fact about this installation is that the cooling load becomes greater than the heat load when the outside temperature reaches 50 F.

Other Big Pumps

A recent announcement points to another big heat pump installation, this one by an electric utility company for its new home office building. This seems significant, for the system for such a building would most likely be selected with economy as one of the most important requisites.

The building (Fig. 4) is a 10-story office structure being built by the Columbus and Southern Ohio Electric Co in Columbus, Ohio. It will

Fig. 3. Dalles Dam power house in Oregon will be air conditioned by 500-ton pump

be cooled and heated by a York 550-ton two-stage heat pump of the air-source type, and will air condition 180,000 sq ft of office space, without the addition of any supplemental heating equipment.

A third, and very unique, example of a large heat pump job, is the installation in the Dalles Dam power house, on the Columbia River in Oregon (Fig. 3). This is to be a 500-ton unit and will air condition the entire power house. Very unusual is that the generator cooling water will be used as the source of heat. Water taken directly from the Columbia River will be the source of cooling. The generator room will be kept at a temperature of 50 F, and the rest of the power house at about 72 F.

These are just a few instances of the *big* jobs which are popping up all over the country. The large job-engineered installations seem to be the ones which give real economy. The important factor is that in such jobs every possible advantage can be taken of favorable air and water conditions and of the utilization of waste heat. For instance, under conditions where the building requires heating and cooling at the same time, waste heat from one cycle can be used for another, i.e., the heat from the refrigeration compression cycle can supply heat units to the heating system.

Also, the big installations are of a magnitude, dollar-wise, which justifies full-scale engineering and the study necessary to utilize every Btu, one way or another.

Big-Pump Engineering

The large, custom-built heat pump systems are usually of the water-source or air-source types. The third method, in which ground-heat provides the heating, is not usually practical due to the higher cost and impracticability of burying sufficient pipe to furnish necessary capacity.

As for the controversy over one-stage vs two-stage compression: in a paper presented to the American Power Conference by Sydney M. Miner, two-stage compression is recommended as being best suited to large heat pump installations. He points out that multi-stage compression delivers equal (or greater) output capacity with lower power input. This fact was established in many years of ice-cream plant and other low-temperature experience. By the use of standard components, one stage (compressor) can be used as the high stage, and the other can be used as a booster; and the booster compressor can be one of relatively lower cost, because of the lower pressures involved. Under certain load conditions, the summer cooling compressor capacity might be used for the high stage of the heat pump cycle; and, if the installation is multi-stage, a portion of this capacity can be dropped down and used for the lower stage as a booster.

Miner further states that in actual practice many plants operate single-stage when compression ratios are low; then convert the same equipment to two-stage when higher compression ratios are needed (that is, lower evaporator temperatures). However, the decision as to one-, or two-stage compression is only one of many factors which must come into the engineering and economic study of a heat pump installation.

Standard Components Used

Some of the earlier heat pump information appeared to be quite complex and tended to surround the subject with a certain amount of mystery. Recently, however, the manufacturers of heavy refrigeration equipment are stressing the fact that most large heat pump installations are made up of standard, conventional equipment. Certainly, conventional compressors are used, the type being determined by the operating characteristics of the job. Reciprocating and centrifugal types are generally used in large installations, for the high stage, while rotaries are more applicable to the low stage, or booster cycle. However, as stated above, the one set of refrigeration equipment will serve for both high stage and booster, if conditions are right.

If the heat pump uses the air source for heat units, the standard evaporative condenser is used as the outdoor heat pick-up unit. It must be designed for either wet or dry operation, because it must function both as an air-cooler and as a condenser. Standard heavy-duty industrial units serve well in this capacity.

Fig. 4. Heat pump has been selected by Columbus and Southern Ohio Electric Co

If the heat source is well water, standard pumps do the job; other water-handling equipment is standard components, depending on the design conditions. Water settling and treating equipment may or may not be required; if required, conventional units are used in such applications.

As to heat exchanger equipment, the decision rests on whether the air conditioning system is designed for forced-air or circulated-water distribution. There are two schools of thought on this subject. Also, the matter of whether the installation is to go into an existing building or a new one will influence the selection.

If the system is to be designed for forced-air distribution, a specially designed plenum, together with conventional fans, coils, etc, is required. If it is a circulating-water system, a conventional heat exchanger of the shell and tube type will be used.

Heat pump control systems are naturally more complicated than those of regular air conditioning systems, but the complete instrumentation of all controls can be worked out with standard units which have been in general use for some time.

Building heating and cooling is by no means the only application of heat pumps in *continued on page 114*

Fig. 1. General arrangement of CEICO car dumper sampler; sampler pipes, upper left—crusher and riffler, foreground. See Fig. 4

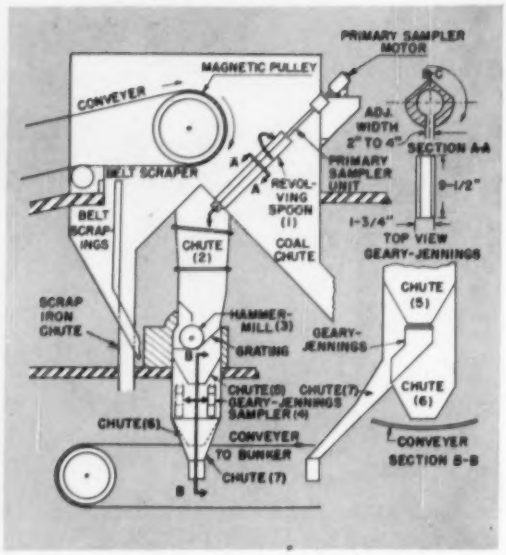


Fig. 2. Revolving spoon sampler uses Thorsten primary sampling unit together with Geary-Jennings equipment

MECHANICAL COAL SAMPLING . .

Yes, says author, if the right equipment is used, and here are his facts and figures to prove it.

By C. W. STEVENS

THERE HAS NOT BEEN as much progress made in the procurement of good samples of coal as in the development of boilers and equipment that burns the fuel. Improvement in sampling methods has been retarded because designers and developers of steam equipment were not so concerned with that facet of the operation.

Recent progress in sampling methods has been given its greatest impetus by operating men — chemists, coal buyers, test engineers, and others working in operations. Perhaps equipment manufacturers may have lagged on this score because the investment in sampling equipment is such a small item as a component of a $50,000,000 steam power plant. Yet the annual investment in coal to produce power during normal life time of this generating plant, cumulated for that 35 year life period, may more than double the dollars put into building the original plant.

A simple coal sampling machine that helps get lots of samples with minimum outlay of labor and minimum effort on the part of that labor may produce greater savings than the gain proportionately obtained by considerably greater investments in heat saving equipment. This author used to sample coal off the cars and hand tamp and crush the samples gathered. It was hard work. We did not fulfill current ASTM requirements in either total pounds taken or in number of increments of minimum weight. Table I lists these minimum weight and increment requirements of the American Society for Testing Materials. The mechanical sampler of today, with crushing and riffling completed within the system, greatly exceeds the ASTM minimum requirements. The bucket-scoop hand sampling technique, along with hand tamp crushing, usually falls short of these specifications.

Revolving Spoon Sampler

Figure 2 shows the flow diagram of a revolving-spoon sampling machine using a Thorsten primary sampling unit and the Geary-Jennings equipment. The revolving spoon rotates so that its open slot cuts across the stream of the coal, crushed to about ¾-in. top size. At this point of the conveyor system carrying the coal to the boiler bunkers, the coal has been turned over four times: at car dumper, pit feeders, conveyor to crusher house, and at the conveyor to the sampling system in the sampling station. The coal entering the spoon has been well mixed and diminished in size so as to give a good representative sample of the coal passing to the bunkers.

The rotating speed of the spoon is varied to meet the tonnage and time involved in taking the sample. It takes about seven to ten minutes to unload a car of 50 to 70 tons respectively. The spoon is set to rotate at 4 rpm, once in 15 seconds. In ten minutes, 40 increments totaling about 1200 lb of sample will be accumulated, more than the quantity required by ASTM Designation 4–21, D-492, or Bureau of Mines Technical Paper 133.

For daily bunker samples, where over 2000 tons of coal pass in 24 hr, the speed of rotation is reduced accordingly. All of the coal sampled by the spoon (1) passes through the chute (2) to the pulverizer (3) and to the Geary-Jennings riffler (4). This riffler extracts about 10 per cent of the gross sample in a closed galvanized can, the balance of the coal being returned to the conveyor that carries the coal to the boiler bunkers. Coal in the can is immediately quartered by hand and the laboratory samples placed in sealed glass quart jars. The entire operation of sampling takes about 15 minutes, just long enough for the car to be emptied from the car dumper and permit another to take its regular turn.

However, in order to get that sample, the 600-ton pit at the car dumper must be emptied and all belts cleared before the car to be sampled is dumped. The car-dumper operator signals the sampler in the tower when the pit is clear and he dumps the car;

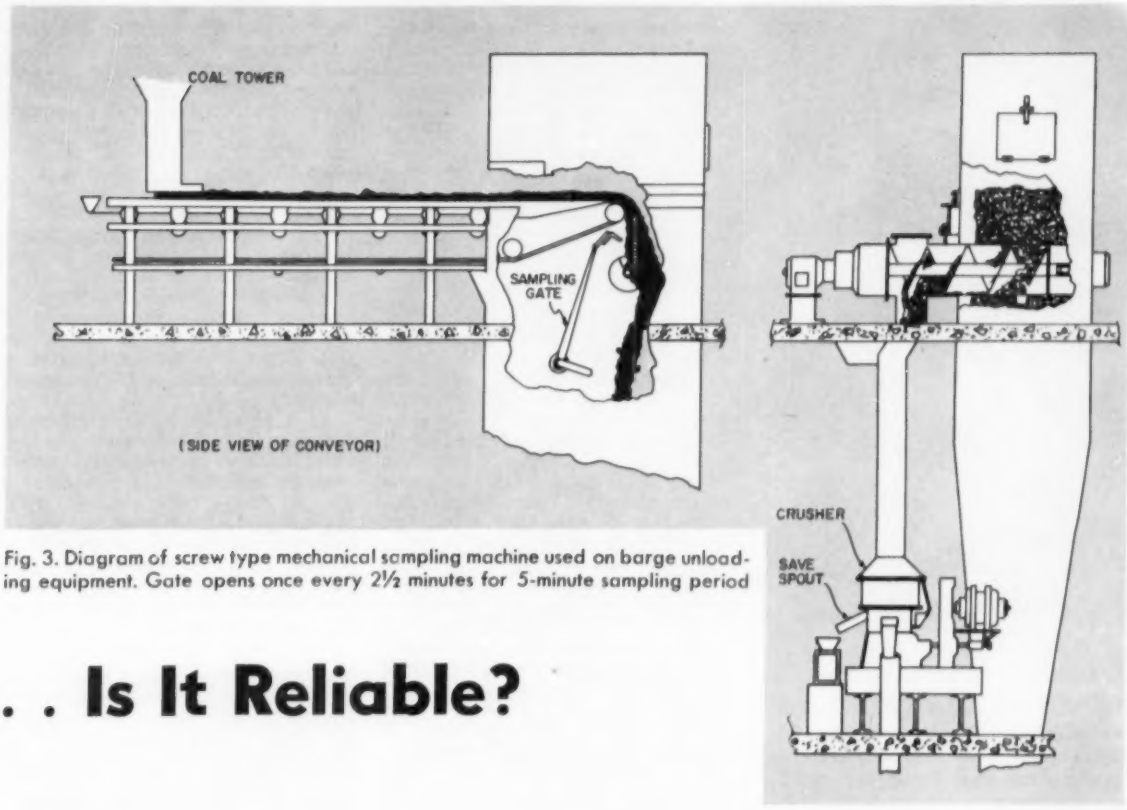


Fig. 3. Diagram of screw type mechanical sampling machine used on barge unloading equipment. Gate opens once every 2½ minutes for 5-minute sampling period

. . . Is It Reliable?

the sampler then gets a clean can and readies the equipment for the break in the flow of coal that warns of the approaching new coal. Delays that occur in the dumping operations for sampling, extra time required for emptying the pit, etc., reduce unloading capacity so that the number of cars that can be sampled per day is limited. Where possible, composite samples are taken of as many cars of each shipper as are gathered on the tracks for that day. This not only removed the breaks between samplings, but augments the tonnage of the coals sampled for each shipper.

Objections Answered

There have been objections raised as to the accuracy of this rotating spoon type of mechanical sampler, e.g: failure to cross the entire stream of the belt, and rejection of larger lumps by the slot of the spoon. We might rebut these alleged weaknesses by pointing out that the coal has been well mixed by the four turnovers ahead of the spoon, and that the incoming coal has been crushed to ¼-in. top size.

In order to check these "weaknesses," samples were taken simultaneously while a given coal was being used at two stations that fired with pulverized coal. At Station A, the Geary-Jennings spoon mechanical sampler was used and 1000 lb of coal cumulated by the rotating spoon. At the same time, a plant technician took 1000 lb of coal sample by means of a hand shovel moved across the belt. Meanwhile, at Station B, another technician took a separate 1000-lb sample of the same coal by means of a hand shovel across the belt in the same manner as the hand sampling at Station A. All samples were crushed in laboratory sample crushers located at the two separate stations. Plenty of increments were assured in these samples. Laboratory results are tabulated for comparison in Table II. The deviations from the average or median are small enough to satisfy the skeptics of our sampling procedures, as well as ASTM specifications. Whenever we sample by hand at either of these two stations, we accumulate over 1000 lb of coal sample, with many over the required

Table I. Specifications for coal amounts and increments considered to constitute minimum sample of tonnages up to, including 1000 (ASTM Designation: D 492-48)

Size range of coal, in.	Group*	Per cent Ash	Increments, minimum		Minimum wt. of gross sample (lb)
			Number	Wt. of each (lb)	
⅜ by 0	1	under 8	15	2	30
		8 to 9.9	20	2	40
		10 to 15	35	2	70
⅜ by 1¼	2	under 8	15	4	60
		8 to 9.9	20	4	80
		10 to 15	35	4	140
1¼ by 2	3	under 8	15	6	90
		8 to 9.9	20	6	120
		10 to 15	35	6	210
2 by 6	4 & 5	under 8	15	10	150
		8 to 9.9	20	10	200
		10 to 15	35	10	350

* Groups 1, 2, & 3, resultants and sized coals; Group 4, sized coals only, 2 by 6; Group 5, resultants only, 2 by 4.

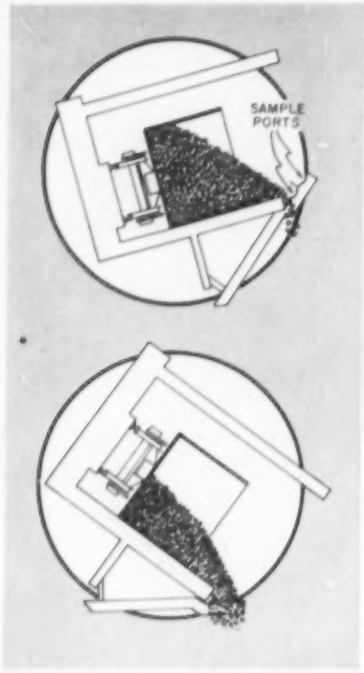


Fig. 4. Diagram of CEICO sampler shown in Fig. 1. Top layer hits tubes first, is discarded; main body of coal crosses ports, is collected during car rotation

number of passes or increments. We have full confidence in our results and usually have no difficulty in resolving any differences with other sources of analyses, especially where the latter have no responsibility in the taking of the samples.

Another method of mechanical sampling of coal is illustrated in Fig. 3. This sampler utilizes a screw conveyor that cuts across the full stream of coal coming over the end of the belt. A sampling gate directs the coal over the screw. The crusher, riffler, and save spout are all located within the flow of the sampled coal so that the sampling effort is practically automatic, free from human handling.

The author has no data on this sampler for comparison with other methods. It does overcome one of the criticisms mentioned in the discussion of the spoon method by cutting across the full stream of coal emerging from the end of the belt. It also has the capability of taking all sizes of coal that would normally be expected from the belt. It retains the disadvantage of requiring that coal pits be cleaned of all other coal that may lie in the pit before dumping the car to be sampled.

Some Disadvantages

Greatest disadvantage to both of the above methods of sampling off the belt is that the cars of various shippers must be isolated, pits and belts cleared, and care taken to keep the different coals segregated and identified throughout the unloading of all of the cars, and the handling of the coal to the bunkers. This consumes considerable time. It limits both sampling and car unloading capacities. Where a station is supplied from many different sources and all unloading is accomplished in the single day shift, sampling may become a problem. The principles behind both of these methods, spoon and screw conveyor, are essentially the same, that is, they both remove a given quantity of coal in a given time by a revolving device whose capacity is controlled by the speed of rotation.

The Cleveland Electric Illuminating Company has developed a mechanical sampler that extracts the coal sample from the car of coal while it is being turned over by the car dumper.* Three lengths of 8-in. pipe attached to the dumper side wall are spaced to pick up coal throughout the length of the car by cutting across or through the falling stream of coal as the dumper unloads the car into the pit below. The pipes are fixed at a predetermined angle to cut the stream at right angles at all times throughout the rotation of the dumper. Two ports or openings are cut into each of the three sampling pipes, sized to pass a 5-in. lump.

As the car dumper turns, the coal pouring out of the car slowly fills up the pipes and the bottom hopper, taking a continuous sample across the three sections of the car. When the dumper returns to its upright position the small hopper gate automatically opens and discharges the coal sampler into the crusher and riffling system that ends up with the quart jar sample. The entire operation from car to jar is a matter of about 90 seconds.

Figure 1 shows the general arrangement of the tubes, hoppers, conveyor, crusher and Galigher Junior sampler, with the operator holding the final sample jar. About 120 lb of coal are sampled per car of 50 to 70 tons. All of the requirements of ASTM Specification D-492-48 are met. Fig. 4 illustrates the operation of the car and tubes in the movement of coal.

As summarized by Bur, this direct car sampling shows many advantages, such as complete mechanization, independence of contents of dumper hopper pits, weather, order of car sequence, minimum manpower, time and effort, greatest capacity of number of samples taken and cars sampled in the 8-hour day, lowest cost of installation and operation for the results obtained.

Photo courtesy Starkevant Mill Co

Fig. 5. A typical coal sampling unit with cover open to show construction

*Automatic Sampling of Coal at Car Dumper, by Armand Bur, *Combustion*, August 1953.

Table II. Analysis comparison of three coal samples sampled by hand method and by mechanical rotating spoon equipment

Item	Station A		Station B	Average, all three results	Deviation from average by three samples		
	Mechanical sample (1)	Hand, sample (2)	Hand sample (3)		(1)	(2)	(3)
Moisture, per cent	3.69	3.35	3.59	3.54	+0.14	−0.19	+0.04
Ash, per cent	7.50	6.83	7.59	7.13	+0.37	−0.30	+0.46
Volatile matter, per cent	29.66	29.64	29.76	29.69	+0.03	−0.05	+0.07
Sulphur, per cent	0.97	1.03	0.95	0.98	−0.01	+0.05	−0.03
Btu per lb							
As received	13,530	13,630	13,503	13,554	−24	+74	−51
Dry	14,048	14,108	14,006	14,054	− 6	+54	−48
Ash-moisture free	15,235	15,180	15,203	15,206	+29	−26	− 3

Underfloor ducts for electrical service make an economical and flexible system for bringing in power for bench work. Looks of the shop are also vastly improved, as this example proves

By C. J. BUICE*

Not a Feeder in Sight

Fig. 1. Had overhead feeders been used, the 60,000 sq ft area would have been a costly wilderness of conduits. The 250 separate bench sections are used for assembly, production and testing of electronic components, need flexible system

A MULTITUDE of varied electrical services required for production and testing operations at the new Lexington Road Plant of Western Electric Company, in Winston-Salem, N. C., pointed to the installation of an underfloor duct system in one of the manufacturing areas. Plans were accordingly carried out and results have been satisfactory, both from the standpoint of the original cost of the installation, and also in changes and rearrangements which have occurred in the two years the plant has been in operation.

The ducts serve an area of approximately 60,000 sq ft, and have provided a most flexible distribution system. At the same time, the appearance of the manufacturing area, in which it was installed, has been greatly improved by minimizing the overhead drops required. Large areas are left virtually clear, with the exception of a few scattered water and air lines which could not be incorporated into the system.

Area served by the underfloor duct system is essentially bench area, and is used for assembly, production, and testing of electronic components. Services required for distribution in the area consist of 60-cycle, 400-cycle, direct current, standard frequencies, and telephone lines. Not all of these services are required on all benches. However, any of the services are readily available throughout the system.

These feeders, if overhead, would provide quite a problem, in that our shop operations *continued on page 116*

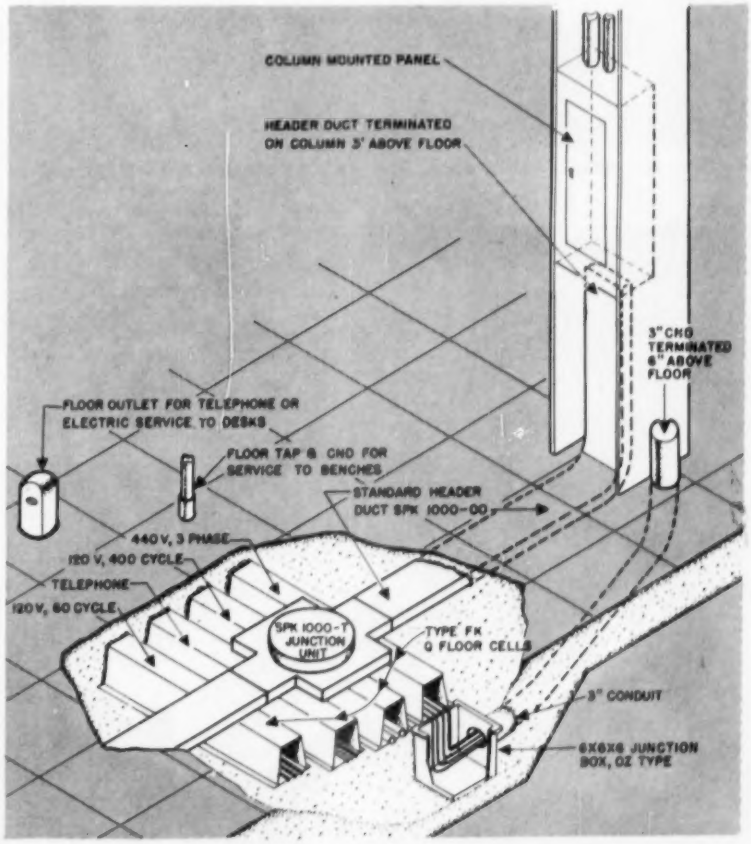

COLUMN MOUNTED PANEL
HEADER DUCT TERMINATED ON COLUMN 3' ABOVE FLOOR
3" CND TERMINATED 6" ABOVE FLOOR
FLOOR OUTLET FOR TELEPHONE OR ELECTRIC SERVICE TO DESKS
FLOOR TAP & CND FOR SERVICE TO BENCHES
STANDARD HEADER DUCT SPK 1000-00
440 V, 3 PHASE
120 V, 400 CYCLE
TELEPHONE
120 V, 60 CYCLE
SPK 1000-T JUNCTION UNIT
TYPE FK Q FLOOR CELLS
3" CONDUIT
6X6X6 JUNCTION BOX, OZ TYPE

Fig. 2. Plan showing construction of underfloor duct system using inverted structural sections of Q floor in 100-ft lengths on 23-ft centers. This spacing saved about $125,000 in materials and provides a 4-cell duct located under each bench

*Factory planning engineer, Western Electric Co., Inc., Winston-Salem, N. C.

NAPE Stresses Education At Diamond Jubilee

National Association of Power Engineers holds 75th annual convention at Grand Rapids, Michigan, June 23 to 28. Members discuss coming trends in power field, need for more education to meet them

Fig. 1. President Walter A. Lamb opens meeting of 141 delegates from NAPE Chapters

Fig. 2. Professor Paul J. Grogan, University of Wisconsin, addresses delegates

CELEBRATING its 75th Diamond Jubilee, the National Association of Power Engineers (NAPE) held its annual convention June 23 to 28 in the Hotel Pantlind, Grand Rapids, Michigan. Keynote of the convention was a reinforcing and increasing emphasis on the educational program that NAPE has always carried on throughout its 75 years of continuous existence.

From the various chapters of the association, 141 delegates attended the convention and more than 500 members, their wives and families, came for the occasion. Besides these, thousands of people from all over Michigan attended the Power Show and Atoms for Peace exhibit staged in the civic auditorium of Grand Rapids as a part of the convention program.

Much interest was created by the various meetings of technical sections of the association held along with the regular business sessions. Speakers at these sessions were leading engineers from various manufacturers in the power engineering field. They covered thoroughly such subjects as air conditioning, labor relations, industrial lubrication, institutional engineering,

Fig. 3. J. D. Holmes, Chairman of Educational Committee and newly-elected President of NAPE, reports to the delegates on the results of the educational program under his supervision

Fig. 4. One of the many NAPE committees holds an informal meeting in the main convention hall, after delegates' meeting. Much of the NAPE business is carried on by such committees

Fig. 5. General view of the Power Show held in the Grand Rapids Civic Auditorium in conjunction with the NAPE Convention

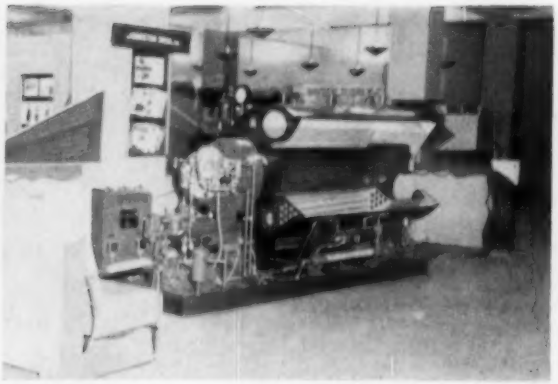


Fig. 6. Cut-away package steam generator was feature in Power Show. Show also included Atomic display furnished by AEC

water treatment, steam turbines, piping and valves.

Condensing and extraction type steam turbine construction and operation were explained in detail. Data were given on the mechanical drive steam turbine, of which large numbers are in use in all types of industrial power plants and processes. Fundamentals of the gas turbine and its uses in industry were explained.

In the water treatment session, data were given on internal boiler water treatment, laying up boilers, dealkalizers and the application of the various methods of water conditioning to different industrial boiler plant conditions and types of water. Lubrication of turbines, gearing and air compressors was discussed. Particular attention was devoted to methods of providing dry compressed air to the users.

One of the general sessions heard an interesting talk on engineering education for the future by Professor Paul J. Grogan, Associate Professor of Mechanical Engineering, University of Wisconsin, and head of the University Extension Division.

In that capacity, he has prepared the correspondence course on power plant practice that has been taken by many NAPE members during the past four years. By passing this course, the student receives a certificate of engineering from NAPE. (Readers of Power Engineering are also well acquainted with his practical articles.)

Details of the association's progress in advocating and publicizing the three home study courses in power plant practice were given by John D. Holmes, of Magnus Chemical Company, 1957 vice-president of NAPE and chairman of the combined Certificate of Engineering and Educational Committee. He reviewed the great response of the associations' members to the educational program and the fact that many new members and several new Chapters have resulted from this opportunity for personal and job betterment. This is particularly true of the younger men in the organization. These are the men who must meet the challenge of increased demands for power, new methods of producing it, the coming atomic technology and other developments to come.

At the annual banquet, Dr. W. E. Sirton, vice-president of the University of Michigan, spoke on the way in which certain fundamental principles drawn from science and engineering can be applied to social problems.

In honor of Walker L. Cisler, president and director of The Detroit Edison Co, a dinner was given on June 27, in the Civic Auditorium. It was open to the public and was well attended by engineers from over Michigan, in tribute to his accomplishments in the fields of engineering, government and civic and state affairs. Mr. Cisler addressed this meeting on atomic power development, based on his past and present work in this field.

The Jubilee meeting was presided over by Walter A. Lamb of Catlett Engineers, Inc. For the ensuing year, the present vice-president J. D. Holmes of Magnus Chemical Co. was elected president. Ivan Cronkhite of Sutherland Paper Co. was elected vice-president to succeed Holmes. Present secretary Edward Schuetz, boiler inspector, City of Milwaukee, was re-elected, as was Treasurer Arthur B. Mitchell of the Chicago Housing Authority.

Annual Convention in 1958 will be held July 13–18 in Atlantic City, N. J.

Fig. 7. Steam Turbines: (l to r) E. B. Clement, Clement Electric Chairman; W. B. Wilson, G. E.; H. Steen Johnson, Elliott; S. D. Fulton, Westinghouse; W. B. Tucker, Allis-Chalmers

Fig. 8. Lubrication session: (l to r) M. A. Jurgens, General Motors, Chairman; B. Dunham, Sun Oil; A. P. Swanson, Standard Oil; R. Price, Socony-Mobil; C. P. Monti, Texas Co

Are Heads Valuable? Utility Thinks So!

COMPREHENSIVE HEAD protection safety program — engineered by Otter Tail Power Company of Fergus Falls, Minn. — has resulted in an accident frequency rating that is approximately 10 per cent of the figure compiled in 1949.

In 1949, the company reported 72 lost time accidents with a frequency rating of 42.06. The mishap rating has steadily decreased each year, reaching only 4.45 during 1956. Just how effective the hard-hat program has been can be determined from the following accident account:

A coalman at the Otter company's Crookston Plant was unloading coal recently from a bottom dump railroad coal car. At the same time, portions of a nearby roof covering were being replaced and a 75-pound section of the old roofing slid from the sling, was "caught" by the wind, and fell 52 feet (Fig. 1). The falling roof section struck the worker on the side of the head, knocking him to the ground. X-rays of the coalman's head indicated that he did not receive head damage from the accident, largely because of the effectiveness of his safety helmet (Fig. 2).

Story behind the adoption of the dielectric safety hats is an interesting one.

Safety Director Poole first singled out a line construction crew of 18 young men and reviewed the protective qualities of the safety hat. Mr. Poole then asked each of the men to wear the hats for six weeks. At the end of that time a conference was held to discuss the matter. The linemen were then requested to wear the safety helmets another month.

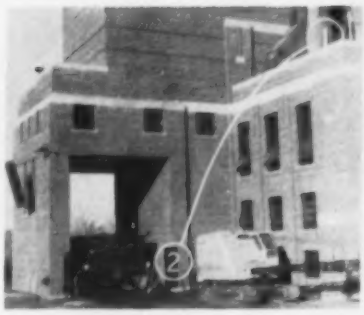


Fig. 1. A 75-lb section of old roofing slipped from sling, fell 52 ft, struck workman at (2); helmet saved his head

Fig. 2. Safety helmet shows force of blow that knocked a workman to ground; X-rays showed no head damage

At the end of the second trial period the men voted for mandatory use of the head protectors by all personnel.

However, no attempt was made to issue the safety hats to other employes. Instead a "wait and see" attitude was taken. It wasn't long before other line crews and plant personnel began asking: "Aren't our heads as valuable as their heads?"

Management of the power firm then knew it was the proper time to announce the mandatory head protection program for line personnel.

Now, all plant and line electrical employes are fitted with and issued White Type B Skullgard Caps and dielectric hats as well as being instructed in their use. Both the caps and hats are numbered with 1-inch wide Scotchlite tape.

New Rod-Driving Technique Speeds Work on the Power Line

A UNIQUE combination of two pieces of compressed air equipment is used by the Utilities Line Construction Co to ground a 33-mile transmission line for Jersey Central Power and Light Co, reducing the labor and time required.

A stake driver and pneumatic hammer are mounted on a Schramm Pneumatractor, a self-propelled air compressor (Figs. 1 and 2). Used instead of customary sledge-hammer or electric hammer methods, this rig is reported to drive a 10-ft rod into the earth in 30 sec, as compared with 15 min by usual methods.

Fig. 1. Stake driver and pneumatic hammer are mounted on a mobile air compressor and moved into position by pole

The consistency of the soil in the grounding area naturally has a direct bearing on the time required to drive each rod. In the swampy area encountered by the Jersey project less than 30 sec was not infrequent. A rocky soil could be expected to increase the driving time but not to the level experienced with customary methods. The greatest depth reached by Utilities Line was 190 ft. More than 8000 rod sections were required.

An 80-lb breaker, or pneumatic hammer, attached to the stake driver is lowered by hydraulic action until it exerts pressure on the top of the ground rod without the hammer in action. The hammer is then turned on. Through a combination of hammer action and hydraulic pressure, the 10-ft rod is driven into the ground. Additional rods are screwed into place and driven with the same technique.

Fig. 2. 10-ft rod is held by self-releasing fingers on guide bar. Hydraulic hammer is lowered to rest on top of rod

$$Ca^{++} + Na_2Z = CaZ + 2Na^{+}$$

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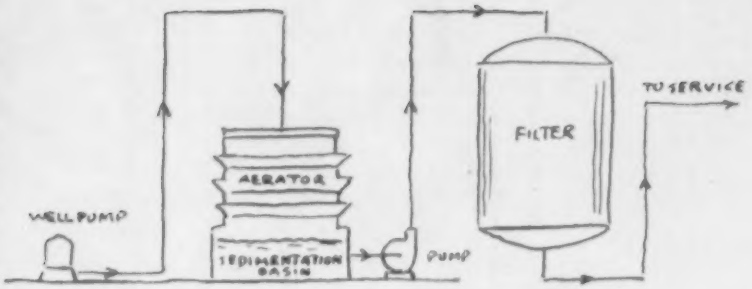
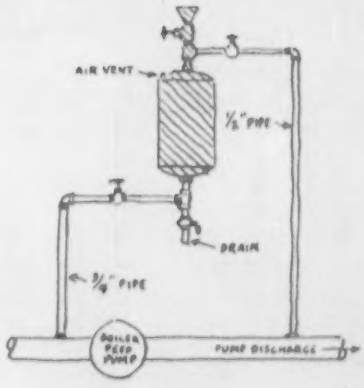




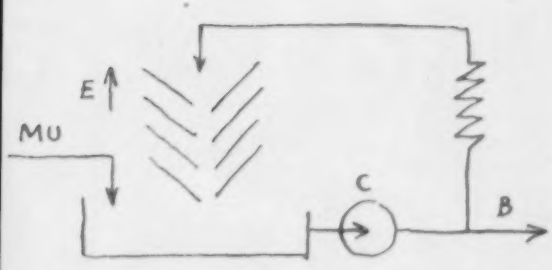
$$V = \frac{18.5D^2(S_1 - S_2)}{Z}$$

any way you figure it,

the best solution to your

water problems is . . .

$$\frac{x}{m} = KC^{1/n}$$



BETZ LABORATORIES INC., Philadelphia 24, Pa.

Basic Facts About Transformers

IT IS USUALLY considered, as a matter of definition, that a distribution transformer, is a transformer whose rating is 500 kva or less. It is used for distributing power from high voltage lines to locations where a lower voltage is required.*

Transformers rated above 500 kva are classed as power transformers.

Polarity is of interest to maintenance men primarily on account of its bearing when paralleling or banking two or more transformers. In order to simplify the work of connecting transformers in parallel, all leads brought out of the case or tank are marked by a system of letters and numbers. The lead marking appears on the diagram nameplate or connection diagram which accompanies the transformer.

Standardization of Polarity Markings

The rules of the A.S.A. provide that in general, leads should be distinguished from one another by marking each lead with a capital letter followed by a number. The letters to be used are "H" for the high voltage leads and "X" for the low voltage leads and the leads of either winding brought out of the case to be numbered 1, 2, 3, etc., the highest and lowest numbers marking the full winding, and intermediate numbers marking fractions of winding or taps. All numbers are to be so applied that the potential difference from any lead having a lower number toward any lead having a higher number shall have the same sign at any instant.

In the case of three phase transformers, the high voltage leads should be marked H1, H2 and H3 and the low voltage leads X1, X2 and X3. The markings shall be so applied that if the phase sequence of voltage on the high voltage side is in the time order H1, H2, H3 it is in the same time order of X1, X2 and X3 on the low voltage side. In order that the markings of lead connections between phases shall indicate definite phase relations, they shall be made in accordance with one of the three phase groups as shown in Fig. 1.

The angular displacement between the high voltage and low voltage winding is the angle in each of the voltage vector diagrams between the line passing from its neutral point through H1 and X1 respectively.

On transformers with six phase winding, the markings shall be so applied that when the phase sequence of voltage on the three phase side is in the time order H1, H2, H3, it is the time order of X1, X2, X3, X4, X5, X6 on the six phase side.

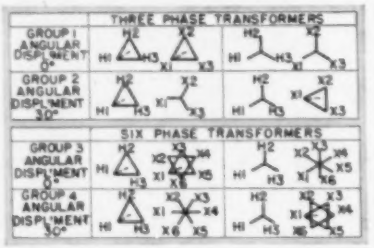

THREE PHASE TRANSFORMERS
GROUP 1 ANGULAR DISPLACEMENT 0°
GROUP 2 ANGULAR DISPLACEMENT 30°
SIX PHASE TRANSFORMERS
GROUP 3 ANGULAR DISPLACEMENT 0°
GROUP 4 ANGULAR DISPLACEMENT 30°

Fig. 1. Polarity markings are standardized by A.S.A. rules. Markings of lead connections between phases are to indicate the definite phase relations

* From *Maintenance Hints*, by Westinghouse Electric Corp

fold along this line—outside edges toward you

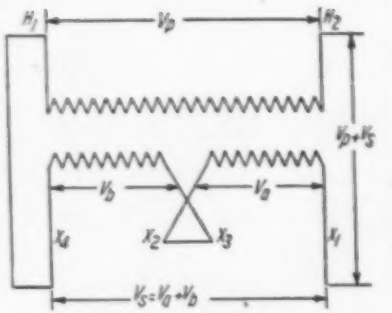


Fig. 2. Polarity test example of additive polarity

Polarity of Single Phase Transformer

Polarity is additive when the instantaneous voltage of the two windings add to each other when connected in sequence around the perimeter of the transformer. Conversely, polarity is subtractive when the instantaneous voltage of the two windings subtract from each other when connected in sequence around the perimeter of the transformer.

For subtractive polarity the H_1 and X_1 bushings are *directly* opposite each other. For additive polarity the H1 and X1 bushings are *diagonally* opposite each other.

Figure 2 shows a winding diagram with additive polarity. Looking from the low voltage side, the left bushing of the high voltage winding is connected to the left bushing of the low voltage winding. A voltage that does not exceed the insulation level of the low voltage winding is applied with high voltage winding. The polarity is additive if the voltmeter across the right high voltage and low voltage bushings read the sum of the high voltage and the low voltage. Note the H1 and X1 are *diagonally* opposite each other designating additive polarity.

continued next page

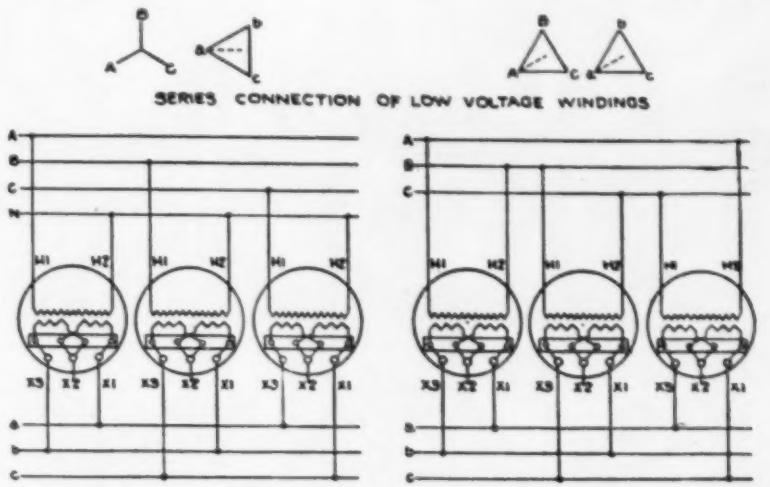


Fig. 3. Typical plan, transformer connections, 3-phase additive polarity. (L) Star-delta, (r) delta-delta

cut along this line

Midwest institution gets lesson in turbine lubrication

. . . learns advantages of using NONPAREIL *Turbine Oil*

In 1939, a Midwestern institution installed a 350 kw. turbine. In less than a year, considerable difficulty was experienced with oil sludge and deposits. A Standard Oil Company industrial lubrication specialist recommended switching to NONPAREIL Turbine Oil as a solution to the problem. He supervised the draining and cleaning of the turbine system and the installation of NONPAREIL Turbine Oil.

The turbine, equipped with NONPAREIL, was started up in June, 1941. Periodic tests showed that the neutralization number of the oil was never above 0.06 mg. KOH/g. Having had this experience with NONPAREIL Turbine Oil, when a new 750 kw. turbine was installed in 1947, only NONPAREIL was considered. In 1954 when a 1,000 kw. turbine replaced the 350 kw. one installed in 1939, NONPAREIL was again the first choice of the institution management.

The reason why NONPAREIL can deliver this kind of performance is this: NONPAREIL is refined from finest quality oil. An oxidation inhibitor is added to NONPAREIL which checks acidity formation even better than natural inhibitors normally found in oil. The inhibiting of acid formation in NONPAREIL is so complete Standard Oil can guarantee that the neutralization number of NONPAREIL Turbine Oil will never exceed 0.15 mg. KOH/g. for the life of the turbine.

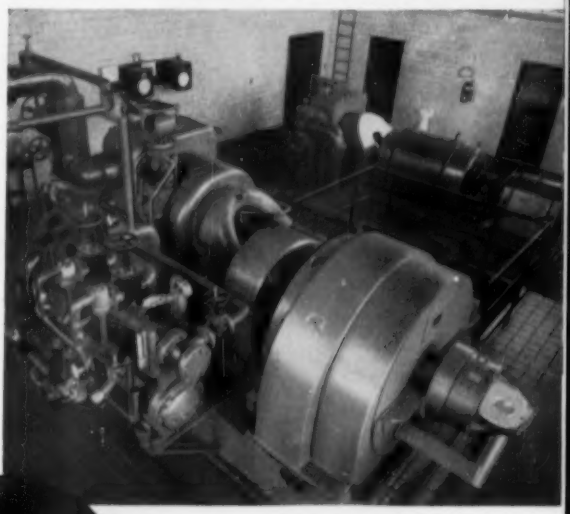
More facts about NONPAREIL Turbine Oil are readily at hand. Get them from your nearby Standard Oil industrial lubrication specialist. There is one of these men in any of the 15 Midwest and Rocky Mountain states. Or write Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

Quick facts about

NONPAREIL TURBINE OIL

- Does not form acids.
- Does not sludge.
- Maintains good demulsibility.
- Guaranteed to last the life of the turbine.

A 1,000 kw. and a 750 kw. turbine provide power to this Midwest institution. Both have used NONPAREIL Turbine Oil since the first day they went into service.



Donald Cripps (right), Standard Oil lubrication specialist, hands John Edyvean, plant superintendent, framed guarantee for NONPAREIL Turbine Oil. Providing technical service on lubrication problems is work for which Don Cripps is well qualified. He's been doing it for nine years at Standard. In addition, he has an engineering degree from Michigan State University and is a graduate of the Standard Oil Sales Engineering School.

STANDARD

STANDARD OIL COMPANY
(Indiana)

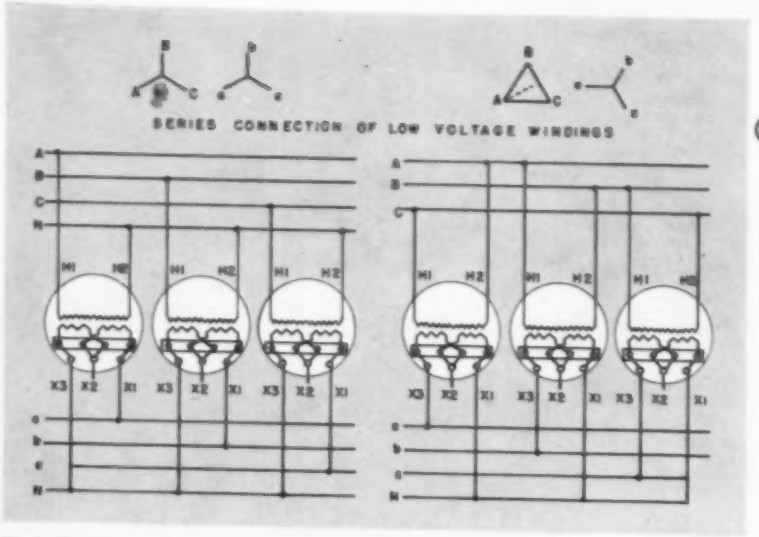
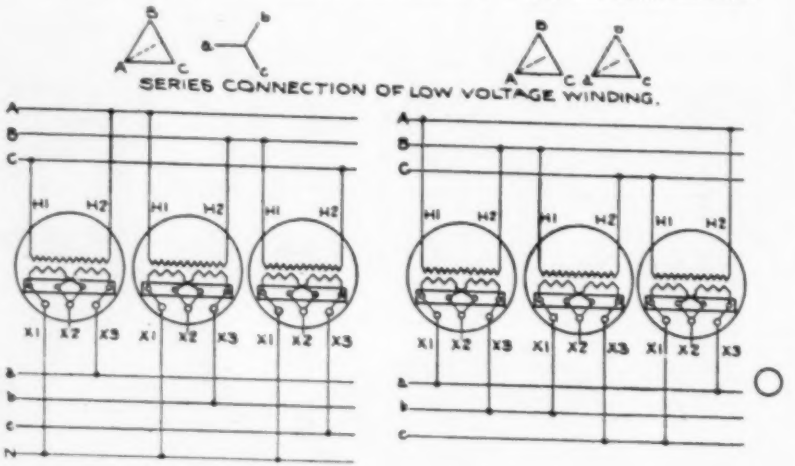


Fig. 4. Typical diagram of transformer connections, 3-phase additive polarity. (L) Star-star, (r) delta-star

Fig. 5. Typical plan, transformer connections, 3-phase subtractive polarity. (L) Delta-star, (r) delta-delta



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Check Polarity Before Connecting

Single phase transformers that are to be operated in parallel must not only have the same voltage ratio but also must have the same impedance. In addition to that the polarity must be the same. Consult the manufacturer's instruction book if not sure of the polarity, check with a voltmeter before making final connections. In an emergency, use lamps or a piece of fuse wire.

Transformers to operate in three phase open delta should have the same voltage ratio and should have approximately the same impedance (a variation of ±7½ per cent is permissible). That is, one may have 3.0 per cent impedance and the other may have 3.23 per cent or 2.77 per cent impedance. The transformers should have the same polarity; that is, they should both be additive or both subtractive polarity.

Transformers connected in delta-delta should have same voltage ratio, impedance and polarity. If not certain of the polarity of the transformers, check the voltage across the secondary terminals before closing final connections. For standard connections to use on single phase distribution transformers for supplying three phase, see the diagrams of Figs. 3, 4 and 5.

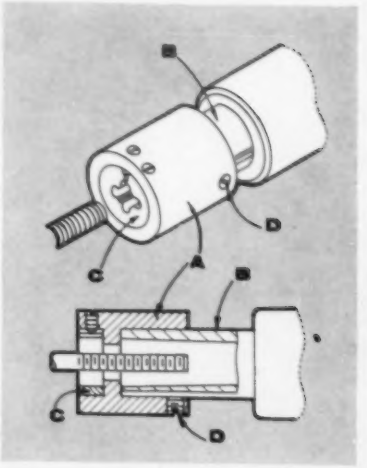
A Simple Lathe Die Holder

By F. E. RILEY

WHEN USING button dies for external threading in the engine lathe, it is common practice to mount the die in an ordinary holder, as used for threading by hand. The die is presented to the end of the revolving work and is backed up by means of the tailstock barrel which is fed forward as the die screws itself along the work. The tailstock ensures that the die is presented squarely to the work, but it offers no support in the vertical plane. If the tailstock barrel pressure is allowed to ease off, the work may be bent.

A simple die holder can be made up which has the advantages of support in the vertical plane while ensuring that the die is presented squarely to the work. The holder comprises a cylindrical steel body, A, bored to a sliding fit on the exterior of the tailstock barrel, B. A recess is turned in the front face of the body to accommodate a standard button die, C, which is held in place by means of the normal three-pointed set screws.

At the start of the threading operation, the die is pushed forward onto the revolving work by means of the tailstock barrel feed. When the die commences threading, it screws itself automatically along the work. There is no necessity for the operator to maintain end pressure on the die since it cannot push up out of line because of the support offered by the barrel exterior. The die will feed along the work and be adequately supported, even if feeding of the barrel is stopped; the holder slides along the barrel exterior.



A is holder, B the tailstock barrel, C is die, screw D has machined end for barrel engagement

Turning of the die holder on the tailstock barrel is resisted by the screw, D, which has a machined end for engagement with the barrel key-way.

cut along this line

Greenlee cuts steam costs 18%-20% burning coal the modern way

Consult an engineering firm

Designing and building hundreds of heating and power installations a year, qualified engineering firms can bring you the latest knowledge of fuel costs and equipment. If you are planning the construction of new heating or power facilities—or the remodeling of an existing installation—one of these concerns will work closely with your own engineering department to effect substantial savings not only in efficiency but in fuel economy over the years.

facts you should know about coal

In most industrial areas, bituminous coal is the lowest-cost fuel available • Up-to-date coal burning equipment can give you 10% to 40% more steam per dollar • Automatic coal and ash handling systems can cut your labor cost to a minimum. Coal is the safest fuel to store and use • No smoke or dust problems when coal is burned with modern equipment • Between America's vast coal reserves and mechanized coal production methods, you can count on coal being plentiful and its price remaining stable.

Expanding facilities at Greenlee Bros. & Company, Rockford, Illinois, created a problem common to many growing firms. The Company's three old boilers had to operate continually at maximum capacity, so that a forced outage could hurt plant production. In addition, peak load operation with outmoded equipment resulted in high fuel costs.

While the newest boiler was retained, Greenlee replaced the other two with modern high-capacity units, including stokers, up-to-date controls and other equipment for more efficient operation. A new, pneumatic ash handling system was installed. Today Greenlee is getting 10%-20% more steam for each pound of coal burned and steam costs are down 18%-20%, saving Greenlee thousands of dollars every year.

For further information or additional case histories showing how other plants have saved money burning coal, write to the address below.

BITUMINOUS COAL INSTITUTE

Southern Building • Washington 5, D. C.

For more data circle 549 on Post Card

Handy Chart for Determining Fan Horsepower

By JOHN D. CONSTANCE

THE CHART OPPOSITE helps in estimating horsepower requirements for moving a given volume of normal atmospheric air through ductwork with resistance measured in inches of water gage ("w.g.).

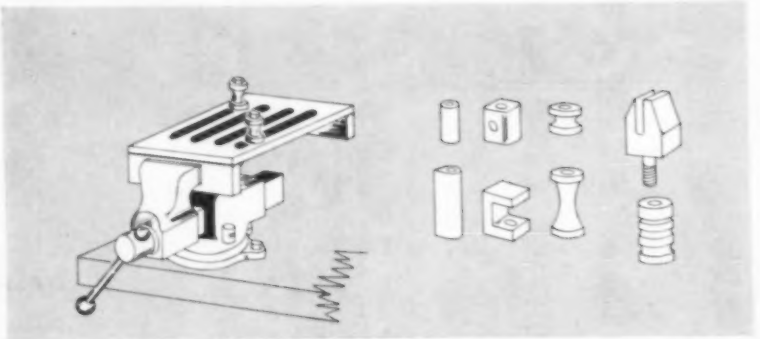
With the air flow known in cubic feet per minute and the system resistance, move across the chart from the vertical scale right to the system resistance line and then vertically down to read horsepower, i.e., air horsepower.

Since a certain degree of inefficiency is involved in the fan, the brake or shaft horsepower from which the fan motor is selected may be determined by assuming a fan efficiency of 50 to 75 per cent, depending on fan design and capacity.

Thus, for an air horsepower of 5 and a fan efficiency of 50 per cent, the brake h.p. is (5)/(0.5) equals 10 bhp.

Basic formula from which the chart was developed is as follows: *.016 air hp per "w.g. per 1000 cfm air flow.*

Simple Bending Fixture Handles Tough Jobs



Bench vise forming and bending fixture pictured here is handy tool for many small jobs around plant

By C. H. WILLEY

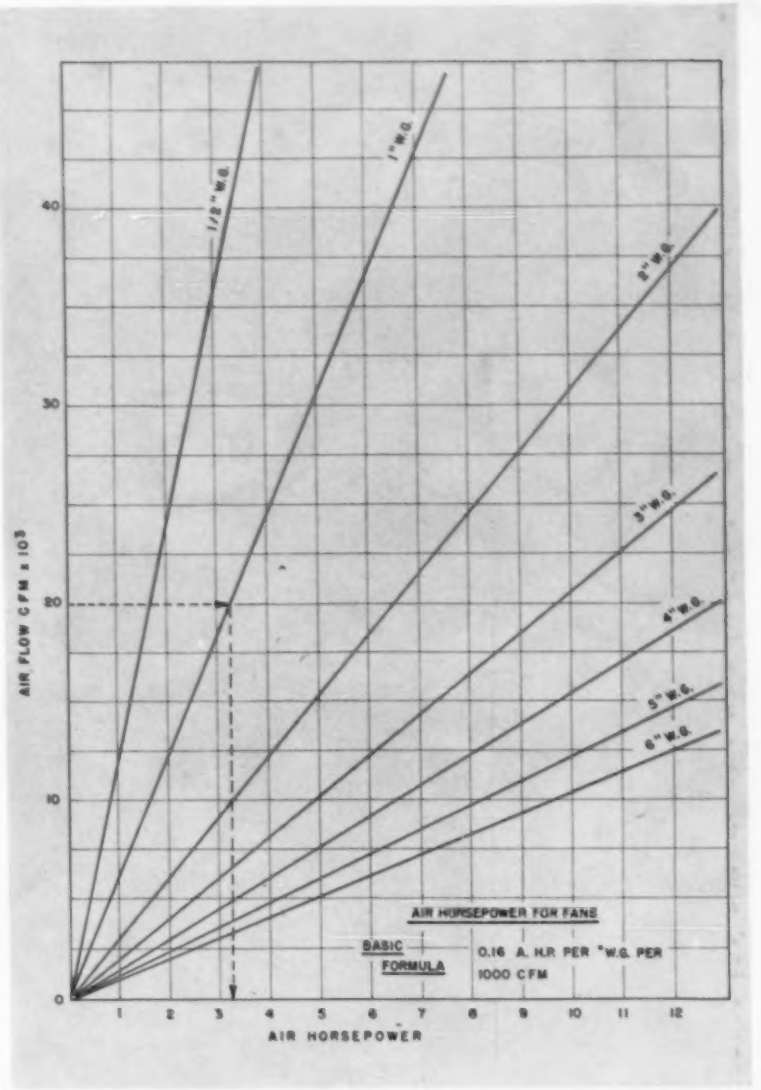
MANY small jobs around the power plant involve bending or forming of tubes, rods, strips, and other metal shapes. The bench vise forming fixture sketched in the illustration is easily made and will lend itself to a large variety of these jobs.

Basic slotted fixture can be made from half-inch steel plate with welded-on supports, as shown, or the plate can be formed by heating and bending. Use the method most suitable to the equipment at hand. Slots should be milled if possible, but can also be made by drilling and filing; absolute precision is not necessary.

An assortment of rolls, posts, and blocks of various shapes can be made up in advance or they can be made up only as needed for different jobs that require them.

Once the fixture has been made, many uses will be found in day-to-day jobs around the plant.

fold along this line—outside edges toward you



POWER ENGINEERING HANDBOOK

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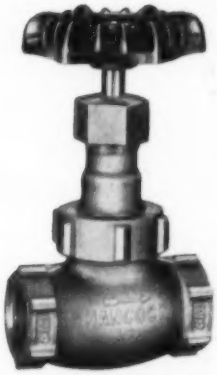
THIS "ACT" COSTS $10.00 AN HOUR . . . AND IT'S NO COMEDY!



Maintenance costs today make ordinary bronze valves an expensive gamble. Such valves with renewable composition seats and discs require frequent maintenance – piping systems out of service – unnecessary labor. And, the cost of a new disc is only the beginning!

You can eliminate both the expense and the problem. Use Hancock Bronze Valves with *superhard* "500 Brinell" stainless steel seats and discs. They last throughout the life of the valve – won't wire-draw, steam-cut or gall.

Be sure of highest efficiency and lowest maintenance. *Specify Hancock Bronze Valves!* Sizes range from ¼" through 2" in globe and angle types, with screwed ends – for all pressures up to 300 psi at 550° F.

PHONE YOUR INDUSTRIAL SUPPLY DISTRIBUTOR for complete information about Hancock Bronze Valves. He is always ready to give you quick service.

When Hancocks go in, valve costs go down

In Canada: *Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario*

HANCOCK VALVES

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For more data circle 550 on Post Card

Ingenuity Turns Pocket Wire Gage Into Handy Tool For Checking

"Wire-Mike" is an inexpensive, versatile device for checking cable and conduit sizes, other jobs

HOW INGENIOUS CONTRACTORS and plant maintenance can transform a small, simple gadget into a handy field tool has been demonstrated by Brooker Electric Company, a Detroit electrical construction firm. During electrical installation at Briggs' new Beautyware plant, Brooker used a pocket gage made by Burndy Corporation, Norwalk, Conn., for a diversity of applications.

Known as the Burndy "Wire-Mike," the inexpensive pocket gage gives direct size readings of cable from #18 through 2000 Mcm; solid wire, from #20 through 4/0; ACSR from #6 through 336.4 Mcm; rigid conduit and copper pipe from ¼ through 2½ in.; and thinwall conduit from ⅜ through 2 in. The Mike is also an inside and outside caliper, calibrated in 1/32 in. and has a handy conversion table covering pipe sizes to inside dimensions.

On the Briggs project and other jobs, Brooker personnel use some 20 of these handy gages to check cable and conduit sizes in the job warehouses, make similar check on installed items, and match cable connectors to installed cable sizes.

Tips on Use of Copper Water Tube

AS AN AID to plumbers, contractors, service men and others who work with copper water and drainage tube, engineers from Calumet & Hecla's Wolverine Tube Division offer the following job tips:

Application. Generally, Type K tubing is used for underground installations. Its heavy wall makes it especially adaptable for this use. Type L is used mostly for interior and general plumbing installations. Type M tubing is recommended for stack waste and vent lines or other non-pressure applications.

Temper. Hard temper tubes are usually recommended where appearance is important and where sagging is detrimental. For instance, where a definite pitch is necessary to eliminate freezing or vapor locks, sagging would destroy the required pitch allowance. Because they are readily bent, soft temper tubes are used when tube must be worked around obstructions or between walls. It is more resistant than hard tubing to bursting caused by freezing of water inside. However, support is required to avoid sagging, as is provided in the case of ground lines.

Expansion-Contraction. A hundred feet of copper water tube, subjected to 100 F temperature change will expand or contract approximately 1¼ in. in length. Therefore, allowance must be made for expansion and contraction when lines are installed.

Bending. Bending is more economical than using fittings — and this should be taken advantage of where possible. Soft copper tubes should be bent gradually, never abruptly. They should never be bent over sharp edges because kinks may result which will restrict flow.

Tube Fittings. Flare-type and solder-type fittings are both obtainable for use with copper tubing. Flare fittings are well adapted for use with soft tubing; solder-type with hard tubing. Soft or silver solders can be used. In either case it is imperative that the surfaces of the tube and fittings be clean and that they be heated properly to assure a free flow of solder and to permit the entire surface of the joint to be filled.

fold along this line—outside edges toward you

How To Get Top Performance From Paving Breakers

By PAUL C. ZIEMKE

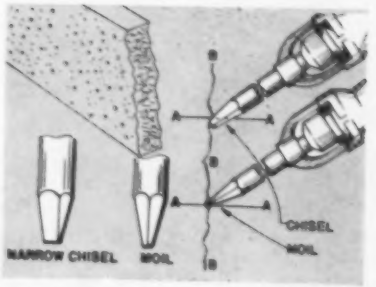
PRIMARY maintenance suggestion is to keep the machine well oiled. Most models have a lubricant chamber built into the handle. It's a simple task to remove the plug and refill the reservoir after approximately four hours of operation. Use the oil the manufacturer recommended in the operation manual.

Second important suggestion is to keep the machine tightened up at all times. The heavy beating the unit receives tends to loosen up side rods, handle bolts and air connection fittings.

Third suggestion is to select the right size of breaker for the job at hand. It makes a great deal of difference whether the job is the breaking up of reinforced concrete, asphalt paving, furnace slag, or possibly baked clay.

With the right selection of breaker must go the right size and type of breaker tools. Contrary to general opinion, it is the opinion of the writer that the use of a narrow chisel is much to be preferred over the widely-used moil. The argument is based on common sense reasoning developed from years of testing work in factory shops, and on contracting jobs. Note the figure: when using a moil, the wedging action is exerted in only two directions — at right angles. The force expended along the line of cleavage marked B-B in the sketch is only partially effective since the concrete resists breaking in that direction. But with the narrow chisel point, all the power of the machine is forced in one direction only, and the concrete is split more readily as the result of the concerted action. A trial run will convince the skeptic.

It is sheer folly to use wide chisels in breaking concrete since this results in severe chisel breakage and limited work output. The wide chisel is effective only on materials such as asphalt, brick and shale. For removing surface asphalt there is available a special asphalt cutting blade which can also be used effectively for compacted clay, ice formations and similar material.



Contrary to general opinion, is the narrow chisel better than the widely-used moil as breaker tool?

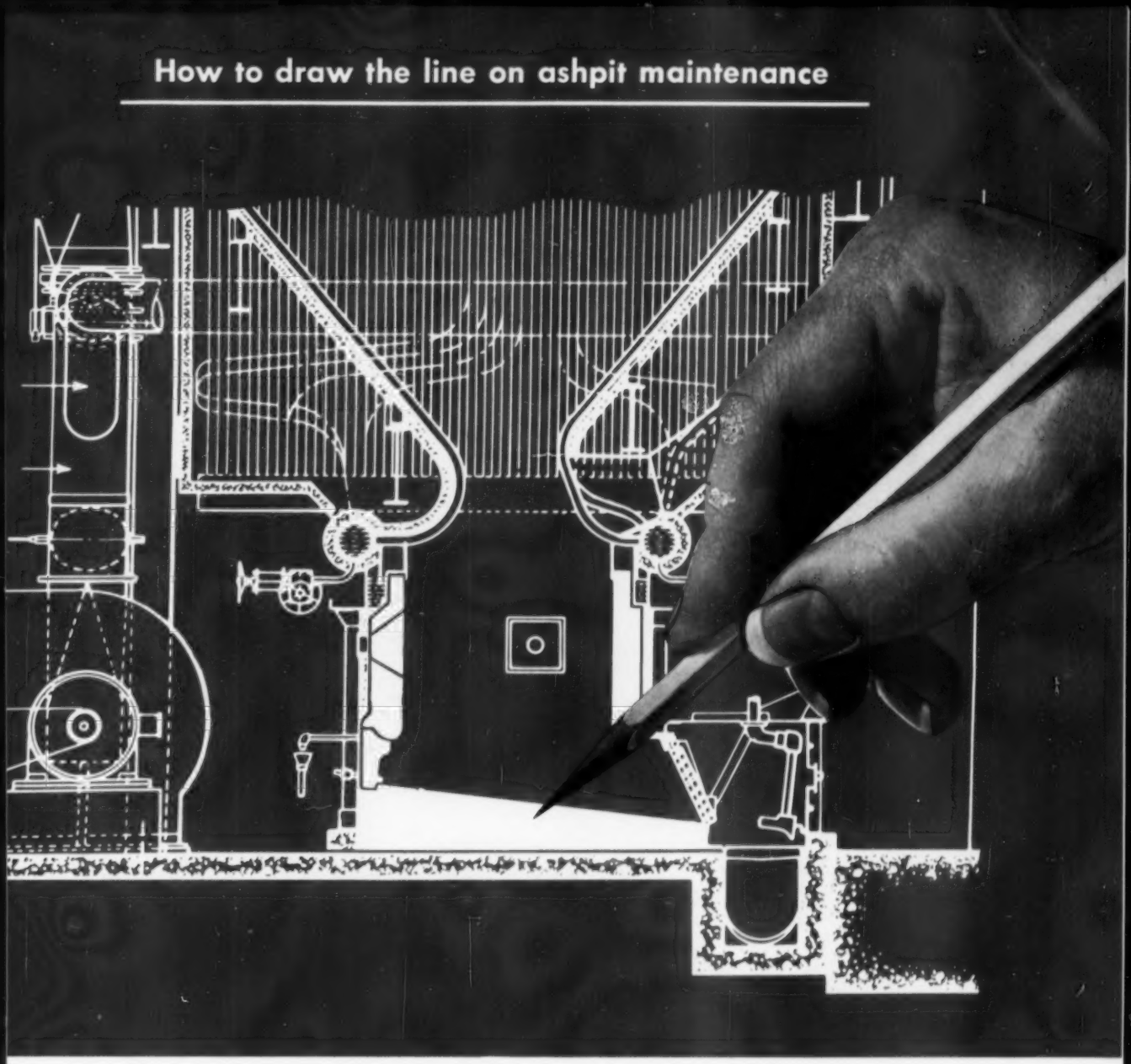
When a chisel breaks underneath the collar on a paving breaker the difficulty is almost always found to be due to excessive prying with the machine when the material in process of breaking is not thoroughly broken up. The answer to the problem is obvious — the machine and blade are just not designed to take that type of excessive beating.

Still other causes of breakage are readily traced to badly worn chucks or dull points. Dulled moil, chisel or blade edges and points are sources of much undue wear on the machines since the blow struck by the air piston is largely reflected back into the machine when the dull bit fails to make entry.

Dull bits are also responsible for the early tiring of the workman, since the rebound and general shaking of the machine and the excessive noise are most trying on both nerves and muscle.

cut along this line

How to draw the line on ashpit maintenance



"Let's put Kaocrete here"

Relining ashpits is expensive and time-consuming. That's why more and more utilities and industrial companies are specifying a heavy-duty refractory castable such as B&W Kaocrete D. On job after job, it has withstood the heavy abrasive or erosive attack of sprays, jets, rakes or shovels.

The reason? Specially designed Kaocrete D has the strength and hardness needed for tough ashpit service. It has unusually high resistance to abrasion, erosion and spalling. It saves time because it can be poured or gunned into place. For less severe abrasive or erosive conditions, B&W recommends Kaocrete A.

Get the facts and figures on these B&W Refractory Castables from your local B&W Refractories Engineer.

Send for Bulletin R-40 which gives data on B&W Kaocrete Refractory Castables for lining ashpits.

BABCOCK & WILCOX

THE BABCOCK & WILCOX CO.
REFRACTORIES DIVISION
GENERAL OFFICES: 161 EAST 42nd ST., NEW YORK 17, N.Y.
WORKS: AUGUSTA, GA.

B&W REFRACTORIES PRODUCTS: B&W Allmul Firebrick • B&W 80 Firebrick • B&W Junior Firebrick • B&W Insulating Firebrick • B&W Refractory Castables, Plastics and Mortars • B&W Silicon Carbide

R-540

For more data circle 551 on Post Card

Truck-Mounted Welding Unit Aids Maintenance

TIRED of pulling heavy welding equipment around the plant for on-the-spot repair jobs, maintenance crews of Clark Equipment Co's industrial truck division converted a battery-operated hand truck into a self-powered mobile welding unit, as the photograph shows.

To the forks of a pallet-type truck, the servicemen bolted a 450-amp welding machine with the control panel welded to the top of the motor case. On the front end of the unit, scrap angle irons and a thin steel sheet were fabricated into a table. Five round steel containers were welded to the table to hold welding rods. At the rear, scrap angle irons were set up to form a frame from which hose, clamps and other equipment could be hung. The unit carries 50 ft of cable for power supply and 20 ft of welding cable.

Check This Fire Extinguisher Selection Chart

THE CHART SHOWN BELOW lists basic types of extinguishers and shows at a glance which to use against the three classes of fire: Class A — wood, paper, rubbish, etc.; Class B — volatile liquids; Class C — electrical fires. Effects of temperature, the operating ranges for each type of extinguisher, how the various extinguishing agents kill fire, and other information on extinguishers are included on the chart.

Copies are available free of charge in quantity from the Fire Equipment Manufacturers' Association, Inc., Suite 759, One Gateway Center, Pittsburgh 22, Pennsylvania

	CARBON DIOXIDE	DRY CHEMICAL	VAPORIZING LIQUID	FOAM	SODA ACID	WATER
CLASS A Paper, wood, excelsior, rubber and general combustible fires requiring cooling and quenching	Small Surface Fires Only	Small Surface Fires Only	Small Surface Fires Only	YES Foam clings to vertical surfaces, wets and smothers.	YES Soda Acid is economical protection quenches and cools.	YES Water is excellent protection. It cools and quenches.
CLASS B Burning liquids (gasoline, paint, oil, grease, etc.) demand a smothering action for quick extinguishment	YES Has no ill effects on food and leaves no residue	YES Chemical smothers fires	YES Vaporizing liquid is converted into a gas—which smothers the fire.	YES Heavy foam blanket on surface of burning liquids smothers.	NO Basic water content will spread liquid fires.	NO Water will spread fire, not put it out
CLASS C Live electrical fires (motors, switches, appliances, etc.) A non-conducting extinguishing agent must be used	YES Carbon dioxide is non-conductor, will not damage costly electrical equipment or leave residue	YES Dry chemical is non-conductor of electricity.	YES Liquid is non-conductor, and will not damage equipment.	NO Foam is a conductor and should not be used on electrical equipment.	NO Should not be used on live electrical equipment; basic water content will conduct.	NO Water, a conductor should not be used on live electrical conductor.
SUBJECT TO FREEZING	No	No	No	Yes	Yes	Yes, unless chemical is added.
EXTINGUISHING AGENT	Carbon Dioxide	Dry Chemical	Heavy vapor formed from liquid by heat	Foam Bubbles	Soda Water Solution	Water
RANGE	5-10 feet	10-25 feet	20-30 feet	25-35 feet	30-40 feet	35-50 feet
EFFECT ON FIRE	Smothers and Cools	Smothers and Cools	Smothers and Cools	Smothers and Cools	Cools and Quenches	Cools and Quenches

NOTE: Equipment should be approved by Underwriters' Laboratories or Factory Mutual Laboratories

fold along this line—outside edges toward you

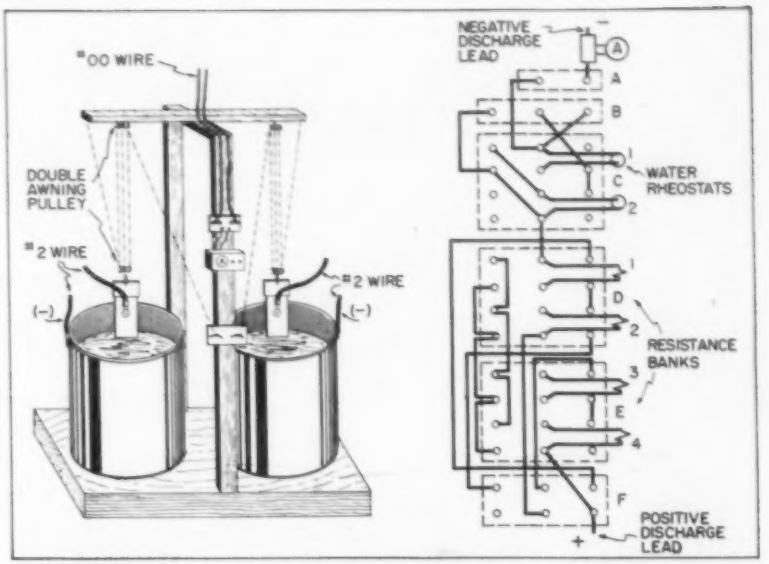


Diagram showing the construction and wiring diagram of water rheostat which you can make yourself

Do-It-Yourself Water Rheostat Test

SIMPLE and inexpensive water rheostat for test discharging batteries has been designed by Gould-National Batteries, as shown in the drawing.

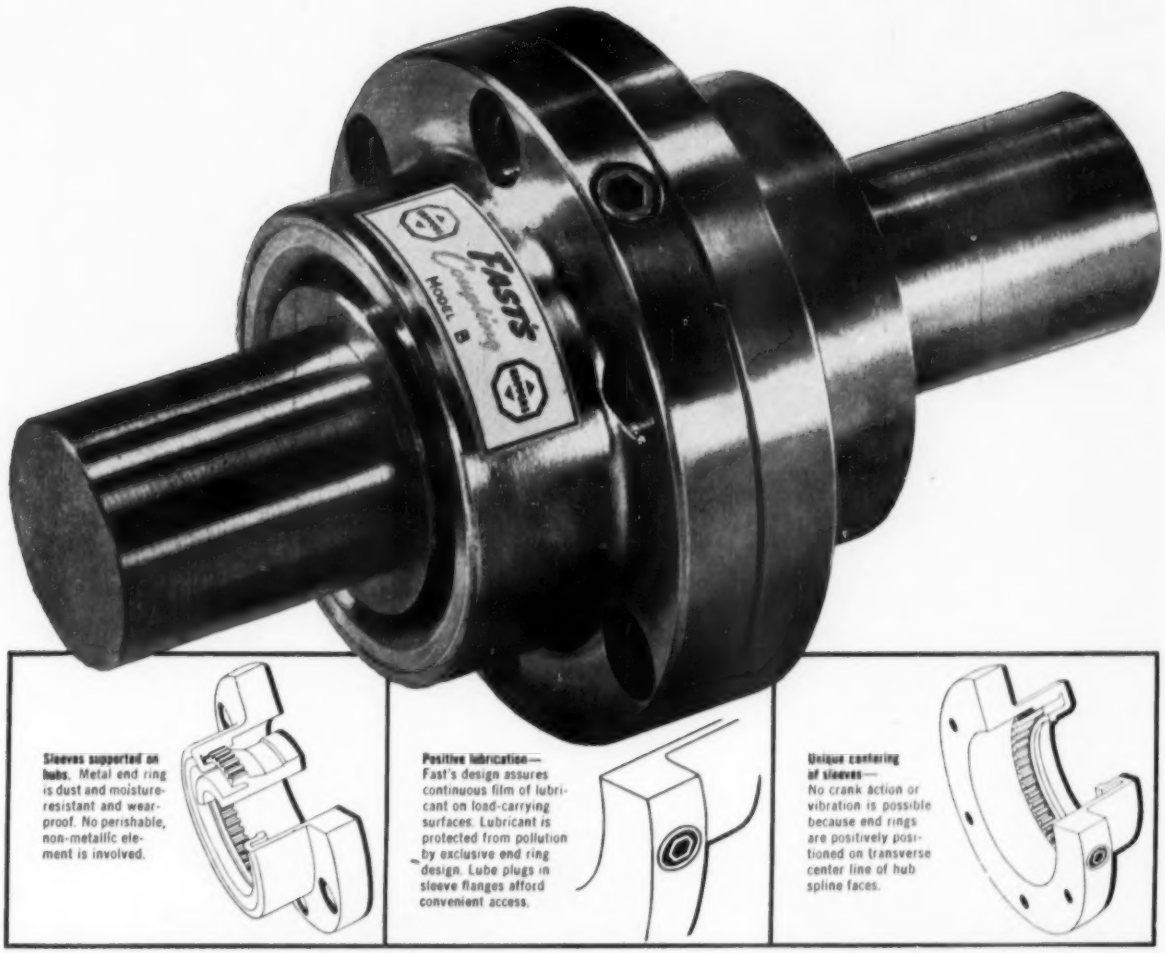
Standard 55-gal steel drums commonly used in industry, filled with salt water, are the principal resistance elements. A wooden scaffold supports the metal bars which are immersed in the barrels. The bars are raised or lowered to vary the resistance by awning pulleys.

The barrel itself is always made the negative and is connected to the negative terminal of the battery being tested. The metal electrode is the positive. The bottom of the drums should be covered with a non-conductor so that the electrode does not touch the bottom of the drum.

Barrel is filled with fresh water into which is mixed 10 lb of salt. An ammeter and switches are placed in the circuit according to the user's requirements and convenience.

Caution: — Protect bottom of rheostat drums, as shown, so that movable center electrode cannot touch bottom. Always connect so that drum is negative in circuit.

cut along this line


FAST'S
Coupling
MODEL B
Sleeves supported on hubs. Metal end ring is dust and moisture-resistant and wear-proof. No perishable, non-metallic element is involved.
Positive lubrication— Fast's design assures continuous film of lubricant on load-carrying surfaces. Lubricant is protected from pollution by exclusive end ring design. Lube plugs in sleeve flanges afford convenient access.
Unique centering of sleeves— No crank action or vibration is possible because end rings are positively positioned on transverse center line of hub spline faces.

Fast's Model B coupling reduces downtime and upkeep for light-to-medium drives

Mechanical flexibility eliminates costly shutdowns and expensive shaft replacements. But—it's only one of many cost-saving features.

Now you can profit from the durability and economy of famous Fast's couplings in a smaller and lower-cost version—available in 3 sizes for shafts up to 2⅝" in diameter.

The Model B coupling gives you the same features that have made Fast's the world's leading coupling for over 35 years. You get the same trouble-free performance, longer service life and lower maintenance costs. You also get prompt delivery because stocks are on hand to meet practically every need. Free engineering service is also available.

Write today for more details to KOPPERS COMPANY, INC., Fast's Coupling Dept., 3708 Scott Street, Baltimore 3, Md.

Engineered Products
Sold with *Service*

KOPPERS

THE ORIGINAL
FAST'S Couplings

For more data circle 552 on Post Card

Chest for Large Tools

THIS all-steel chest, 40-in. long, 16-in. wide and 12-in. high, was designed specifically for safe transportation and storage of large tools such as are used in maintenance and construction work. It is long enough to accommodate a 36-in. sledge hammer, plus giant socket and pipe wrenches. A large tote tray rests on a sturdy removal support which lifts out easily to provide free access to the spacious bottom.

The chest is made of 14-gage steel and finished in durable, corrosion-resistant baked enamel. It has a heavy-duty hasp and staple for padlocking, and strong handles on both ends.

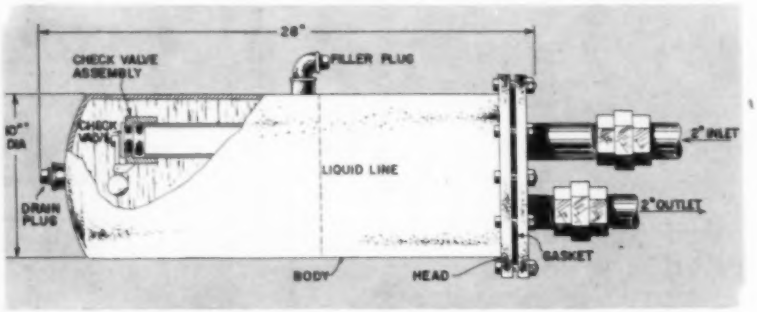
As an accessory, the manufacturer provides 5-in. heavy-duty casters (two with brakes and two without brakes) to make the chest a rolling tool box for use on hard surfaces.

For more information about this useful new chest, write the Handbook Editor, POWER ENGINEERING; or jot Large Tool Chest on prepaid postcard inserted in this issue, and mail.

Tray is 23½-in. long, 3¾-in. wide, 2½-in. deep

Guard Against That Flashback!

By J. K. PAUL



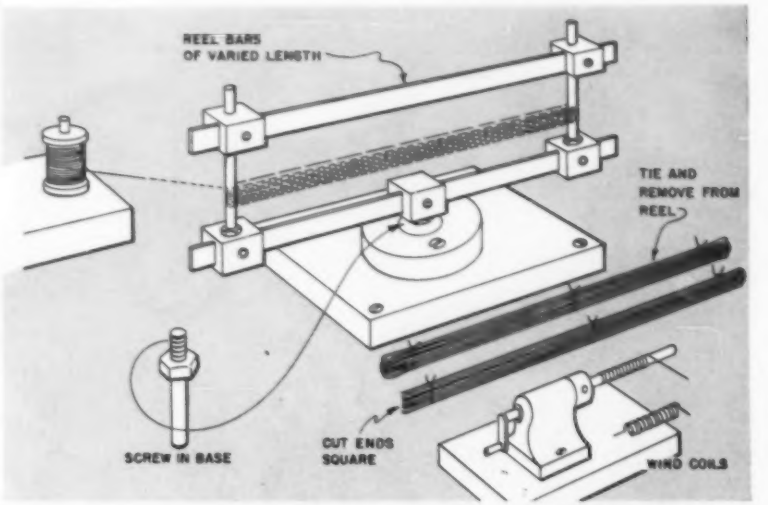
Hydraulic flashback arrestor with 2-in. connections acts as safeguard for welding and cutting operations

THE FIGURE illustrates the type of installation every welding and cutting station should have for protection against flashbacks which may occur as a result of improper admixtures of the oxygen-acetylene gases used in welding and cutting operations.

If a flashback occurs, or a back pressure develops that causes a reverse flow of gas, the water level is depressed until the bottom ends of the vent tubes are reached, and the abnormal pressure then released. When the back pressure ceases, the vent tubes are automatically re-sealed and normal operation resumed.

In northern climates where freezing temperatures render water unpredictable, consideration must be given to a substitute medium. Glycerine is an effective fluid for the purpose.

Adjustable Length Reel Saves Time in Winding Small Gage Wire



Extra bars of varied lengths make this reel useful for winding resistance wire in 8-in. to 3-ft lengths

BY CHARLES H. WILLEY

ADJUSTABLE length reel comes in mighty handy when there's need to wind various amounts of resistance wire from small gage, high resistance manganin or similar wire, for use in coil wound from lengths of 8 in. to 3 ft.

We designed and made such a reel, for winding 100 or 200 lengths at a time, tying them in bundles on the reel, then removing them and cutting the ends to produce the pieces to be wound in the coils.

The sketches show how we built the reel. We used round edge flat stock for the bars, ½-in. by ⅛-in., in several lengths up to 3 ft. The cross-heads were of brass drilled and broached for the bars.

We use only the bottom set of cross-heads and bar when winding up to 100 turns, and attach the top set when more are wound. This prevents the rods from bending. Top part of the rods, above the bars, is used as a handle for the reel.

We find this device saves a lot of time and time is money.

fold along this line—outside edges toward you

cut along this line

alone

Many coals have good qualities—but Franklin County Coal stands alone in its broad market area as a superlative fuel with most of the desirable qualities, least of the undesirable. Old Ben stands alone, too, in its reserves of this great fuel. Although two hundred million tons of Old Ben Coal have gone to market there's still a hundred-year unmined supply. **Old Ben Coal Corporation, Chicago.**

For more data circle 553 on Post Card

Banish **algae scum**

from: **spray towers** **cooling ponds**
condensers **reservoirs**
air conditioning equipment

HTH Granular gives the old heave-ho to algae growths that clog up recirculated water systems, cause heat transfer loss or produce offensive odors.

Containing 70% available chlorine, HTH Granular dissolves immediately to release a fresh hypochlorite solution for sure, fast algae kills. As a rule, about one ounce of HTH per 1,000 gallons of water is enough to control algae growths. Because algae growths form slowly, in most cases only periodic "shot" treatments are required. This, of course, varies with the nature and condition of the specific water supply.

Dry, stable, and easy to use, HTH Granular is the safe, economical way to get rid of algae problems once and for all. It's packed in 100-lb. drums and in cases of nine 5-lb. cans. Check your supplier today or write to us directly.

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HTH 5032

OLIN MATHIESON CHEMICAL CORPORATION
INDUSTRIAL CHEMICALS DIVISION • BALTIMORE 3, MD.

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Big Heat Pumps

continued from page 93

larger sizes. Many commercial processes require heat and cooling simultaneously. A frozen orange juice plant in Florida utilizes the heat units generated in the freezing operation to evaporate the orange juice — all by means of a heat pump. This is parallel to so many similar processes which buy heat units in one cycle, and throw them away in another.

A challenging idea is that of two next-door industries using a common heat pump installation, to their mutual advantage. Of course, the prevailing conditions would have to be right for the project, but the concept certainly bears some careful thought. The utilization of waste heat, in any form, has long been the objective, and challenge, of power engineers everywhere. So why not let heat pumps solve some of these problems?

The Utilities' Viewpoint

In recent years the electric utility companies have experienced a reversal of the winter peak load due to lighting, and have seen a summer load, due to air conditioning, equal or exceed it. So any electrical equipment which will produce reasonably constant demands the year around is most welcome. Some companies now have rate schedules which are favorable to this type of equipment, and it is safe to assume that more favorable and more widespread rates will be developed for the heat pump field.

From the standpoint of power distribution economics, the heat pump field should be most interesting. The additional requirements for transformer and feeder capacity are very slightly higher, if any, for heat pumps over conventional air conditioning installations.

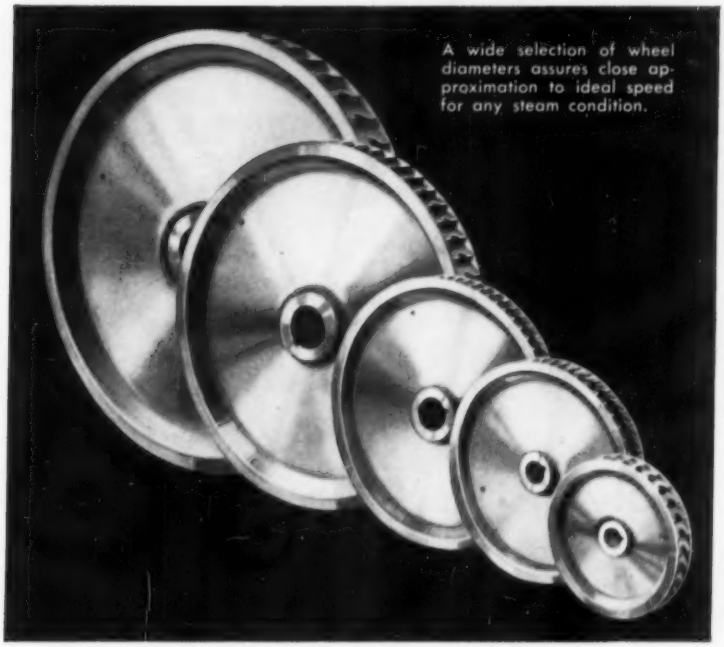
Also on the side of the heat pump is the consideration that in most metropolitan areas the delivery of fuel becomes more of a problem each year, and municipal authorities get tougher in the matter of air pollution.

However, the fact that several utility companies have selected heat pumps for their own headquarters buildings cannot be credited solely to reasons of economy; there is certainly also a sales promotional value to such installations.

Finally, it should be said that the complete cost study of a proposed heat pump installation is not a simple rule-of-thumb process. Rather, it is quite involved and requires the knowledge and experience of engineers who have specialized in this field. But generally speaking, heat pumps are a definite possibility for most large air conditioning applications and should not be ruled out without close consideration.

There's a TERRY wheel turbine to meet your specific needs!

SOLID-WHEEL DURABILITY COMES IN ALL SIZES...



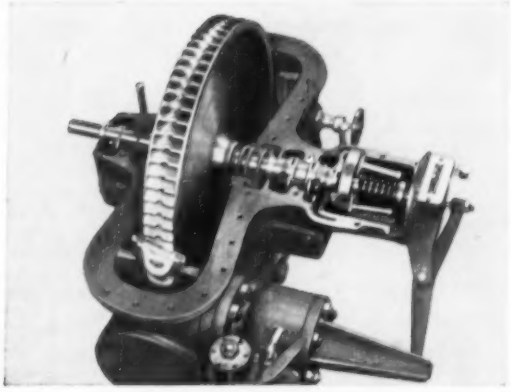
up to 2000 HP

Wherever you need dependable turbine drive up to 2000 HP—and strength and durability are major factors—Terry solid-wheel turbines are specifically equipped for the job. For, within their simple, sturdy casing is a rugged one-piece wheel.

You choose from a broad selection of sizes for all mechanical drive applications—with each Terry wheel turbine accurately proportioned to fit the operating conditions. From the smallest to the largest, these rugged turbines have:

- Solid one-piece wheel.
- Large radial and axial clearances.
- Double rim protected blading.
- Individual nozzle control.
- Dependable and durable governor.
- Heavy dust-proof bearing and governor housing.
- Independent overspeed trip with separate valve.
- Sturdy casing design.
- Strong and easily inspected steam strainer.
- Truly accessible construction, which makes inspection of the interior parts a simple matter.

For full details, send for a copy of bulletin S-116.



Terry wheel turbine with cover removed to show the solid wheel. There are no separate parts to loosen or work out. Blade clearances are generous.

THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.

TERRY

TT-1208

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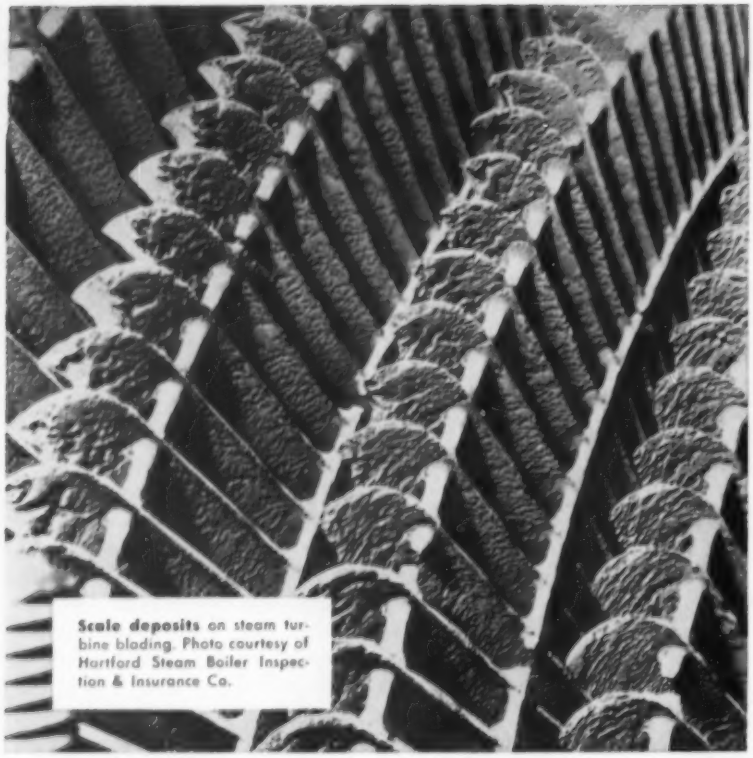

Scale deposits on steam turbine blading. Photo courtesy of Hartford Steam Boiler Inspection & Insurance Co.

No Build-Up! No Blow-Up!

. . . WHEN MODEL 1106 PROPORTIONEER FEEDS BOILER WATER CHEMICALS

Prevent scale build-up (caused by boiler carry-over) on turbine blades with proper raw water or internal steam boiler treatment. Model 1106 Proportioneer feeds all chemicals (alkaline, neutral, or acid) accurately (guaranteed within ±1%) over 15 to 1 range. Capacities range from 0.11 to 35.6 GPH . . . for discharge pressures up to 1100 psig.

PAY LESS, GET MORE!

Design features of this proportioning pump include interchangeable measuring cylinders, super-accurate Vane-Guide check valves, and percentage calibrated stroke-length scale.

Request Bulletin 1106-2 for complete data. Write to PROPORTIONEERS, INC., 385 Harris Avenue, Providence 1, Rhode Island.

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DIVISION OF
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METERS FEEDERS CONTROLS

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Not a Feeder in Sight

continued from page 97

are constantly changing, with power being added and deleted as required over some 250 separate bench sections. Several hundred overhead drops would be required to feed the benches. Besides being costly, an installation of this type would create an unsightly wilderness of conduits extending from benches to trusses, 18 ft above the floor.

The duct system finally worked out consists of inverted structural sections of Q floor, type FK (Fig. 2). Main reason for using this type of duct is that it contains four separate cells, each with a cross-sectional area of 14.62 sq in., and permits great flexibility in that floor taps can be installed at any point desired. Of this 14.62 sq in. per cell, the National Electrical Code allows up to 40 per cent of the area in each cell to be used. The wiring for Q floor is covered in Article 536 of the National Electrical Code. Sufficient headers to feed the system must be added, however, so that the full capacity, as specified, may be utilized.

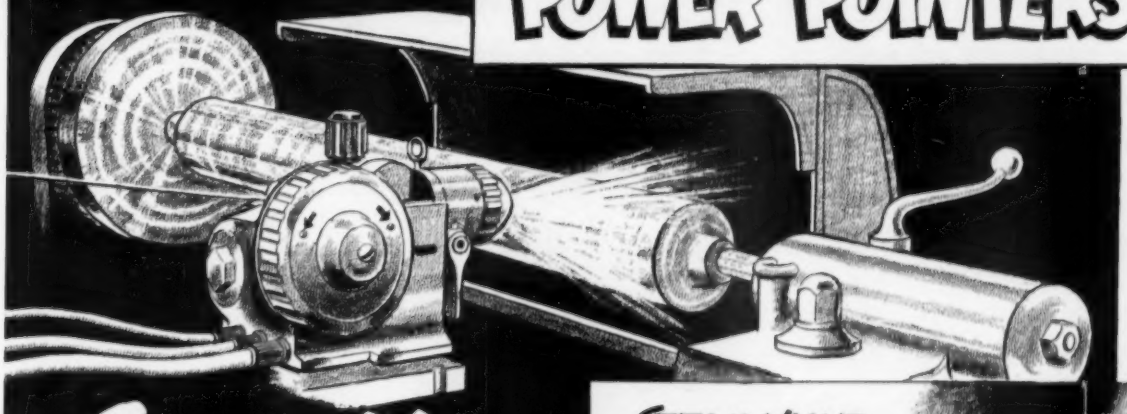
Our installation of this duct is unique in that it departs from the normal installation generally used. The Q floor is normally used as a load-carrying structural member and is laid as a continuous floor. The cells, therefore, are available for wiring over the entire area of the floor. In our installation, we did not feel that 100 per cent floor coverage was necessary, as benches are 21 ft long and installed at right angles to the cells.

Therefore, our system consists of 100-ft lengths of Q floor on approximately 23-ft centers, each containing four cells. This spacing as opposed to a continuous Q floor reduced material requirements by approximately $125,000 and at the same time provides an equal distribution system due to the standard bench layout.

System provides a four-cell duct under each bench throughout the whole area served. Each cell is connected by a header which joins the corresponding cell in all runs terminating (in the case of general 60-cycle distribution) in a flush column-type panel, as shown in Fig. 2.

All other cells, with their respective headers, are fed by 3-in. conduits from surface panels located on columns throughout the area. The Q floor sections were laid in the inverted positions on a concrete pad, on grade, and the floor was poured, leaving the ducts just under the surface. Floor taps normally utilized in Q floor wiring are used, and conduits for general distribution on the bench are connected to the floor taps by means of an Erickson coupling. Deletion of a service merely requires the removal of conduit and coupling and installing a cover in the floor tap.

POWER POINTERS



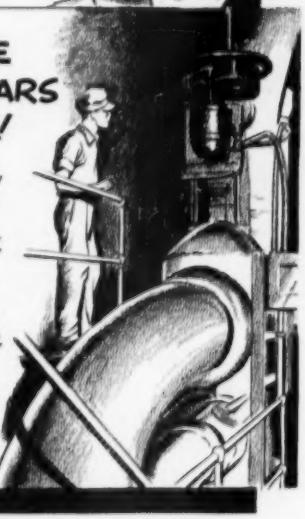
Sprays Monel

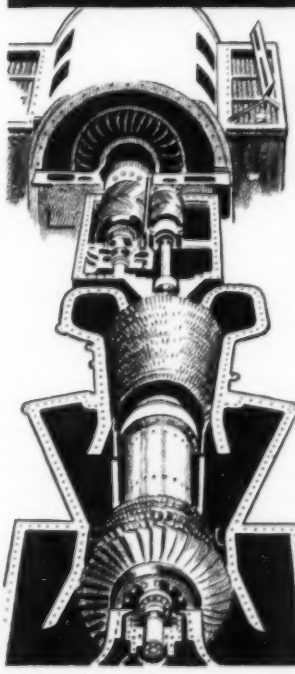
... stops rust-cutting of carbon seals

GLAND SECTIONS OF SHAFTS FOR SMALL MARINE STEAM TURBINES ARE NOW BEING SPRAYED WITH MONEL NICKEL-COPPER ALLOY FROM SPRAY GUNS THAT MELT AND BLAST DROPLETS OF METAL AGAINST THE SHAFTS. BY PREVENTING ROUGHENING OF THE SHAFT THE MONEL* ALLOY COATING HELPS MAINTAIN THE STEAM SEAL ... PREVENTS STEAM LEAKAGE AND RESULTING OIL CONTAMINATION.

STEAM VALVE SERVES 27 YEARS ...NO REPAIRS!

ITS SECRET: THE STEM, SEAT RINGS AND SEAT ARE MONEL NICKEL-COPPER ALLOY. MOTOR ACTUATED, THIS TROUBLE-FREE VALVE HAS RESISTED MORE THAN A QUARTER CENTURY OF EROSION AND CORROSION ON A MAIN STEAM HEADER OPERATED AT 350 PSI AND 700° F.





6,000 hours young

AFTER 6,000 HOURS' SERVICE, TURBINE BLADES, OPERATING AT RIFLE BULLET SPEED (1,200 FT/SEC.) AND AT RED HEAT (1,300-1,350°F. INLET TEMPERATURE) LOOKED AS THOUGH THEY HAD NOT BEEN USED AT ALL. FORGED FROM INCONEL* "X" AGE-HARDENABLE NICKEL-CHROMIUM ALLOY, THESE AND SIMILAR BLADES RESIST CREEP AND EXTREME OXIDIZING CONDITIONS MET IN INDUSTRIAL GAS TURBINES.

These nails are all "drive" and no backing out

ANNULAR GROOVES IN STRONG ANCHORFAST* MONEL NICKEL-COPPER ALLOY NAILS FORCE WOOD FIBERS TO SERVE AS WEDGES THAT LOCK INTO THE GROOVES AND PREVENT THE NAILS FROM BACKING OUT. IN COOLING TOWER SERVICE, THE GROOVES STAY SHARP AND EFFICIENT BECAUSE MONEL ALLOY RESISTS RUST AND CORROSION AND LOUVRES STAY PUT.

UP AGAINST A METAL PROBLEM?

THERE'S A GOOD CHANCE THAT INCO'S MECHANICAL ENGINEERING SECTION HAS SOLVED A SIMILAR ONE OR COME CLOSE ENOUGH TO IT TO SUGGEST A GOOD ANSWER. JUST LET US KNOW THE DETAILS.

THE INTERNATIONAL NICKEL COMPANY, INC.

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INCO Nickel Alloys

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NOW···GLOBE OFFERS···
two new INTERCHANGEABLE trays for support of cables, wiring and tubing

★ Engineered for uniform design and easy installation
★ Steel or aluminum construction
★ Complete accessories for SPEEDIER Installation
★ No sharp edges to damage cables
★ Complete interchangeability

Now, for the first time, two types of cable trays, one a ladder type and the other a basket type, are available to be used INTERCHANGEABLY at any given location, depending on the type and weight of the cables to be suspended. The advantages of each type tray can thus be used to the fullest extent. Globetray, the ladder type, is intended for use where festooning is not a problem, while Cable-Strut, the basket type, is intended for the support of communication wire, instrument tubing and control cables in automation applications.

These two cable trays have been thoroughly field tested in hundreds of large industrial installations, in new plant construction, in power plants, in modernization, and for power distribution in all types of manufacturing processes. A new catalog, just off the press, gives full information and installation techniques. Ask for your FREE copy today.

Distributors are to be found in all principal cities—consult the yellow pages in your phone book under "Gratings" or "Conduits" for the one nearest you.

109

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NEW ENGINEERING BOOKS

Thermal Power From Nuclear Reactors, by A. Stanley Thompson and Oliver E. Rodgers. First Edition, 229 pages, 6¼ by 9½ in., cloth. Published by John Wiley & Sons, Inc, 440 Fourth Ave, New York, N. Y., 1956. Price $7.50.

This is the first book on atomic reactors written from a mechanical engineer's standpoint. Stressing a design approach, the work discusses problems of reactor development which confront the engineer in nuclear power plants. Engineering problem-solving techniques such as numerical and dimensional analysis are applied to these problems, and workable design criteria are evolved. Some of the problems of reactor development treated in this manner are; thermal stresses, transient behavior of reactors, and distribution of gamma rays and neutrons.

The introductory chapters give a concise review of nuclear fission and a general description of nuclear reactors, helpful in orienting the engineer to current thought of physicists. In short, this book fills the need of men with engineering backgrounds as a guide in reactor design, and it also gives the physicist a picture of the engineering implications of nuclear fission.

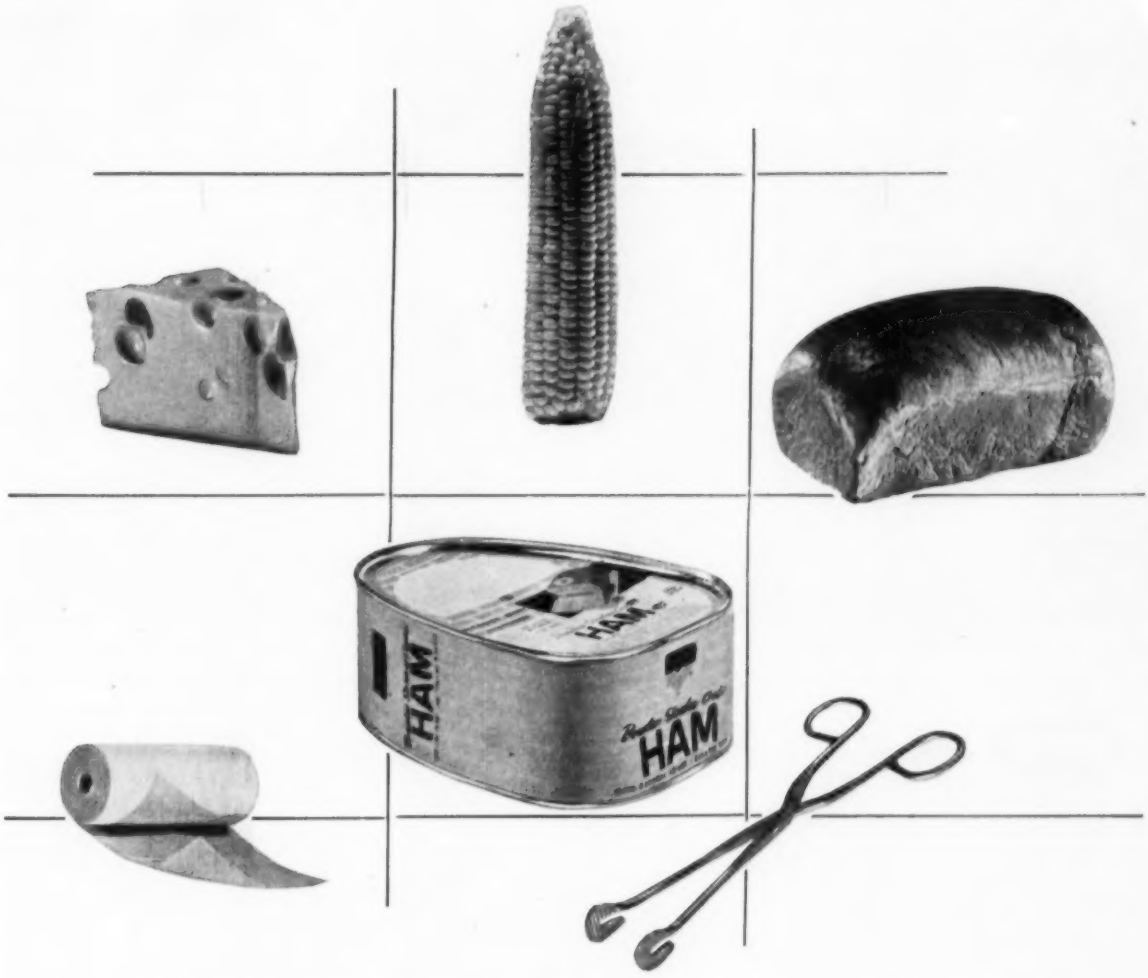
A. Stanley Thompson conceived the idea of writing this book while teaching a course in reactor engineering design at the Oak Ridge School of Reactor Technology where he was chief development engineer for the Oak Ridge National Laboratory. Oliver E. Rodgers contributes to the book his wide experience in the development of rotary machinery for producing power. His experience with steam turbines, turbojet engines, aviation and industrial gas turbines applies well to discussions of power obtained from nuclear sources.

★ ★ ★

The Generation of Electricity by Wind Power, by E. W. Golding. Size 6 by 9 — cloth covered, 318 pages, including index. Published by Philosophical Library, Inc., 15 E. 40th Street, New York 16, N. Y. Price $12.00.

In recent years, important work has been done on the possibilities of using wind power for the generation of electricity. The author of this book has played a prominent part in this work, both in Britain and in other countries, on behalf of their governments and of the United Nations and its specialized agencies. He has here treated the subject fully and authoritatively.

The book deals with the important matter of wind surveys for the choice of suitable sites, with the structure and behavior of the wind and with techniques for measuring it. It also considers in detail the economy of wind power in relation both to large public



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Engineering Books

continued from page 118

supply networks and to isolated premises and committees. There is an interesting study of the use of wind power, a full account of present day activities, and a survey of future prospects. This is a book that will be of interest to all concerned with the provision of electric power, both in industrialized countries and in underdeveloped parts of the world, as well as to engineering students in universities and technical colleges.

* * *

Practical Electrical Wiring, by H. P. Richter. Fifth Edition. Size 5¼ by 8¼, 602 pages, cloth binding. Published by McGraw-Hill Book Co., 330 W. 42nd St., New York 36, N. Y. Price $5.25.

A really worthwhile book for anyone who does, or intends to do electrical wiring of any kind in new or old construction. Here are practical methods explained in plain, easy language. Simple enough for beginners, yet complete enough to be valuable to those already doing electrical work.

Book presents fundamentals, terminology, basic principles, theory behind practices and practical wiring instructions, all based on the 1956 National Electrical Code. In addition to explaining clearly the best methods and approved wiring practices, the book tells why these methods are used. Thus, the reader is prepared to solve both routine and special problems which he will meet on the job.

* * *

Cold Bending of Metals, a Manual of Processes. Revised Edition, 1956. 170 pages, 9¼ by 5¾, loose-leaf. Prepared and published by Wallace Supplies Mfg Co, 1300 Diversey Parkway, Chicago 14, Ill. Price $2.50.

This looseleaf booklet is divided into two sections. The first deals with the cold bending of metals and the second with abrasive cut-machining of metal.

The part on bending covers the technique of making bends, bending on ram automatic machines, on rotary automatic machines and on manual machines. Then follows a description of the most commonly used tools for bending, followed by details of the hydraulic circuits in bending machines. Instructions are given on correct maintenance of equipment and there are also chapters on designing for bending and the theory of cold bending.

The section on abrasive cut-machining explains some of the remarkable advantages of this type of machining, and then discusses such items as correct cutting speeds, the effect of speed on the cut, the provision of adequate driving power for this type of tool, quality of cuts, accuracy of cutting, how to make cuts of various shapes and other information on the technique of cutting with abrasives.

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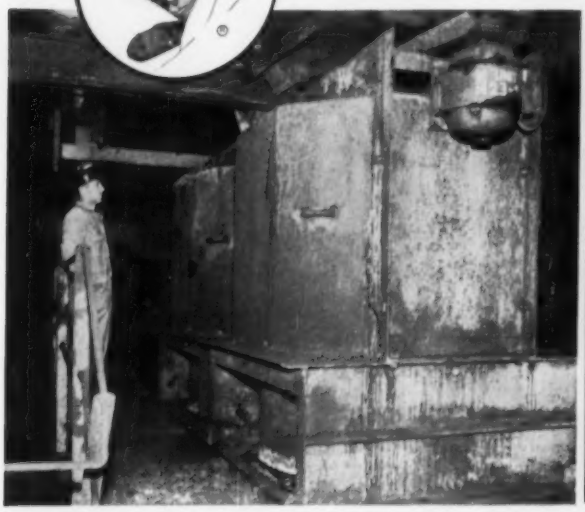

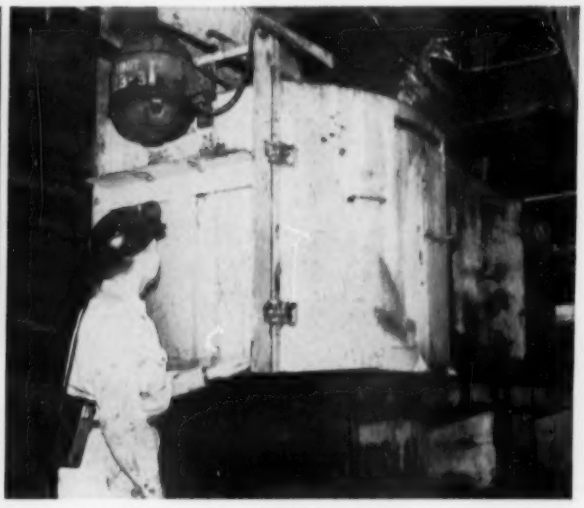

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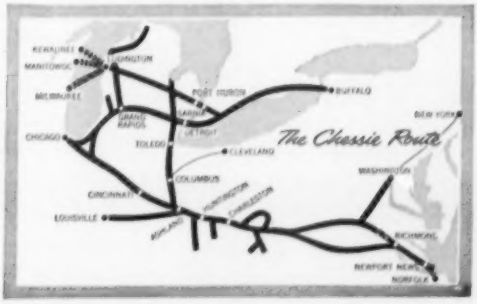

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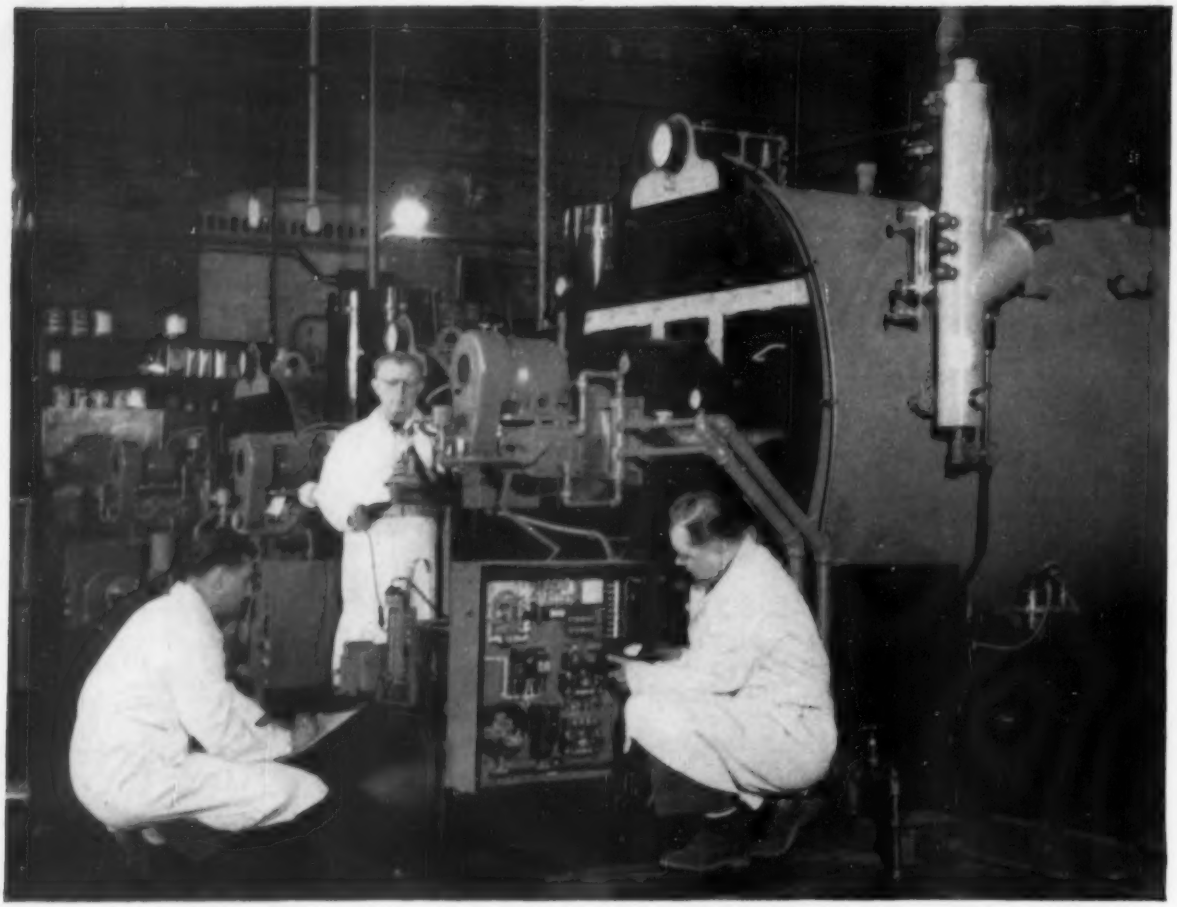

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VALVES, TRAPS, PIPING AND ACCESSORIES

201 **General Purpose Valves** — Supplement No. 1 to Catalog F-9, 32-pp, offers complete information on company's series of general purpose drop forged steel valves, gate, globe and angle types, sizes ¼ through 2 in. Includes descriptions of each type along with drawings showing component parts. Dimensions and other specifications are tabulated, and a pressure-temperature ratings table is included. Henry Vogt Machine Co.

202 **Check Valves** — Twenty-pp Catalog 30 presents company's line of tilting-disc check valves made in iron, bronze and steel for working pressures to 3000 psi. Explains operating principles of tilting disc construction, discusses closing without slam, reduced loss of head, other advantages. Includes construction details, sizes. The Chapman Valve Mfg. Co.

203 **Diaphragm Motor Valve** — Bulletin J-170 describes outstanding features of company's diaphragm motor valve designed for accurate control of pressure, temperature, rate of flow, and liquid level. Cutaway view showing component parts is included, along with data on materials of construction, capacity tables, and flow diagram. The Jordan Corp.

204 **Industrial Valves** — Condensed Catalog 105, 28 pp, contains data on valves for a wide variety of applications. Includes dimensions and illustrations describing non-return (stop-check) valves, globe and angle stop valves, pressure seal design, angle univalves and small size globe valves designed for chain or extension operation in vertical lines. Also included is company's Mudwonder valve for abrasive fluids. Edward Valves, Inc.

205 **Water Hammer Control** — Cause, effect and control of water hammer in piping systems is the subject of 8-pp Bulletin WH 851. Photos, drawings and curves supplement text, and test data is presented to show efficiency of company's silent check valves in water hammer control. Some typical installations are illustrated. The Williams Gauge Co., Inc.

206 **Boiler Blow Off Valves** — Bulletin E-125, 24 pp, describes and illustrates the design and construction of company's quick-operating valves, angle valves, Y valves and duplex units specifically designed for boiler blow-off service. Includes dimensions. Everlasting Valve Co.

207 **Lubricated Plug Valves** — Catalog PV-24, 36-pp, shows in detail a line of iron and steel lubricated plug valves. Many illustrations of the single, screwed and bolted gland type valves are shown, including photos, sectional and detailed drawings. Also included is physical data on dimensions. The Wm. Powell Co.

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5	6	7	8
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17	18	19	20
21	22	23	24
25	26	27	28
29	30	31	32
33	34	35	36
37	38	39	40
41	42	43	44

Helpful Bulletins

101	102	103	104	105	106	107
108	109	110	111	112	113	114
115	116	117	118	119	120	121
122	123	124	125	126	127	128
129	130	131	132	133	134	135
136	137	138	139	140	141	142
143	144	145	146	147	148	149
150	151	152	153	154	155	156
157	158	159	160	161	162	163
164	165	166	167	168	169	170
171	172	173	174	175	176	177

Catalog Library

201	202	203	204	205	206	207	208	209	210	211
212	213	214	215	216	217	218	219	220	221	222
223	224	225	226	227	228	229	230	231	232	233
234	235	236	237	238	239	240	241	242	243	244
245	246	247	248	249	250	251	252	253	254	255
256	257	258	259	260	261	262	263	264	265	266
267	268	269	270	271	272	273	274	275	276	277
278	279	280	281	282	283	284	285	286	287	288
289	290	291	292	293	294	295	296	297	298	299

Advertised Products and Services

501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521
522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540	541	542
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208 **Valve Chart** — Form 194R, 22 pp, is a valve comparison chart, listing valve figure numbers of 15 major manufacturers and the OIC equivalent valve figure numbers. Compares variety of valves in ferrous and non-ferrous materials, describes different valve lines. The Ohio Injector Co.

209 **Bronze and Steel Valves** — Catalog 200, 80 pp, describes company's bronze and steel valves, including globe, angle, gate, Flocontrol and other types applicable to power, petroluem, chemical and general industry installations. Engineering data such as material specifications, flow charts, temperature and pressure ratings are included. The catalog is profusely illustrated with photos, cutaway views and dimensional drawings. Manning, Maxwell & Moore, Inc.

210 **Choosing the Right Valve** — Presenting valve selection as a matter of matching the valve's service characteristics with service requirements of the job, this practical 20-pp booklet explains and illustrates basic design features of gate, globe and check valves. It tells, in non-technical language, how each of these valve types works, and where it is suited for use. Disc, stem connection, bonnet and bonnet-joint characteristics are discussed and illustrated. Crane Co.

211 **Steam Trap Book** — Catalog J, 44 pp, serves as a manual of trapping practice. Includes a catalog section giving physical data and prices on cast semi-steel and forged steel inverted bucket steam traps, compound steam traps and ball float air and air relief traps; a handbook section explaining how to calculate condensate loads and select traps for all classes of equipment; a maintenance section explaining trap installation, as well as repair. Armstrong Machine Works.

212 **Steam Trap Selector** — Twelve-pp Bulletin T-9 is designed specifically to aid in selection and application of steam traps on chemical processing equipment. Features a foldout piping diagram for 22 pieces of typical processing equipment — each showing recommended steam trap and piping arrangements. Also contains selector tables. Yarnall-Waring Co.

213 **To Get at Those Valves** — This little folder describes a sprocker rim with chain guide. The rim adjusts to fit all valve wheels. Babbitt Steam Specialty Co.

MECHANICAL POWER TRANSMISSION

214 **Speed Reducers** — Design and operation advantages of company's line of Torque-Arm speed reducers are outlined in 28-pp Bulletin A-637. Includes selection tables for double and single reduction units, bore dimensions and bushings, data on overload releases, flange mounted speed reducers, and recommended V-belt drives. Dodge Mfg. Corp.

215 **V-S Drive Selection Tips** — Bulletin 20P50, 44 pp, carries handy multi-color tables for quick and easy selection of variable speed Texrope drives. In addition to providing these tables for A, B, C and D section variable speed drives, booklet includes information on design features, drive principles, horsepower rating tables, speed range table. Allis-Chalmers Mfg. Co.

216 **Internally Geared Power** — Featuring latest design improvements in

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122	123	124	125	126	127	128
129	130	131	132	133	134	135
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41	42	43	44		

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501	502	503	504	505	506
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$$\text{Spring deflection} = R(1-\cos\theta) - L(1-\cos\phi),$$

and is graphically illustrated at the right. The upper curve shows that the ring motion at low range exceeds the requirement to produce pen motion linear with flow. Thus, the cam which transmits ring motion to the pen arm can convert this excess ring motion into extra power for precise pen movement.

METERING APPLICATIONS WHICH REQUIRE WIDE TURN-DOWN CALL FOR HAGAN RING BALANCE METERS. You get this feature when you specify Hagan, as well as the following:

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5. Wide range computation and/or compensation by means of built-in, easily checked mechanisms available on most models.
6. Pneumatic or electric transmission also available.

Bulletin MSP-141 describes these features and the new design of the Hagan Ring Balance meter case. ASK US FOR IT.

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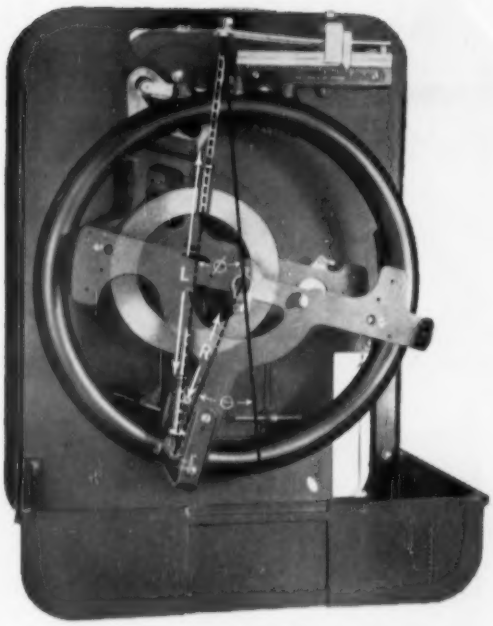
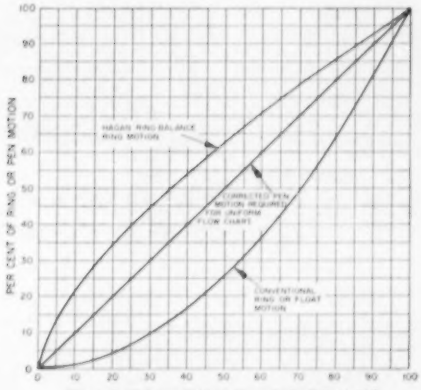


Push rod moves upward against range spring, governing ring rotation in accordance with the diagram below.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PER CENT OF FLOW READING ON UNIFORM FLOW CHART
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Excess motion of the Hagan ring, as shown by upper curve, is converted (with a gain in torque) into linear pen movement by a gently sloping cam.

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gearmotors and embodying 60 multicolor illustrations, 16-pp Form F-1880 shows comparative advantages of gearmotors, lists ratings from ⅛ to 30 hp with gear ratios as high as 10:1. Cross-sectional details and enlargements of outstanding features are included, as well as a discussion of use of elliptoidal helical gears, and a chart graphing degrees of tempering of gear teeth. U. S. Electrical Motors Inc.

ELECTRICAL EQUIPMENT

217 Testing Instruments — Bulletin 19-57, 16 pp, features company's electrical testing instruments, including ohmmeters, ground testers, dielectric test sets, motor rotation tester, cable fault locating equipment, transformer turn ratio test sets, corona test equipment, frequency meters, tachometers, others. Includes photos and descriptions of each type, including chief features, operating ranges, and applications. James G. Biddle Co.

218 On Copper Conductors — Publication C-25, 62 pp, is designed to help make the selection of bus conductors easier. Included in booklet are tables regarding such shapes as channels, ventilated square tubes and round tubes. There are tables for other rigid bus conductor shapes, also data on bare copper wire and cable as well as commonly used alloy wires. Also provided is a general discussion of copper, its physical and electrical properties. Photos illustrate many installations. The American Brass Co.

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219 Selecting Protective Devices — The Protection Handbook, 24 pp, is based on the 1956 National Electrical Code, and interprets this code into easily read form. It covers the selection of protective devices for electric circuits, motors, appliances and apparatus, and includes a list showing the size to use when ordinary fuse, Fustron dual-element fuse or Fustat is installed. All information is condensed. Fully illustrated, book gives wiring diagrams, motor tables. Bussmann Mfg. Co.

PUMPS AND PUMPING

220 Controlled Volume Pumps — Bulletin 953, 24 pp, describes and illustrates use of controlled volume pumps in industrial water treating systems. Construction and operation features are described, capacity-pressure ranges and speed and stroke length adjustments are charted. Typical chemical feed and water treating systems are presented through text and diagrams; and an anlysis of boiler water treating systems, cooling water treating problems, and systems for waste and sanitary water treatment included. Milton Roy Co.

221 For Abusive Pumping Jobs — Catalog 4906, 36 pp, covers centrifugal pumps for wide industrial use and especially adapted to handling ashes, abrasive mixtures, slurries, hot and corrosive liquids. It describes several basic types: a horizontal shaft, single-stage side suction pump; a horizontal shaft, single-stage, rear-entrance automatic priming pump; vertical shaft pumps with standard, overhead and quill bearings for wet pit applications. Nagle Pumps.

222 Steam Pump Care — Bulletin G-2280, "How to Install and Take Care of Steam Pumps," is a 24-pp booklet containing a step-by-step series of 88 illustrations showing how to increase the service life of all types of steam pumps. It offers 28 tips on proper installation of the pumps, 54 tips on care techniques. Section on installation provides information on suction, packing the pump, starting it, and trouble shooting. Section on maintenance deals with such subjects as steam valves, liquid piston and rod, piston packing, liners. Worthington Corp.

223 Solids Handling Pumps—Bulletin 121-A, 8 pp, describes a complete line of non-clog pumps for handling solids in suspension. Included are vertical, horizontal and close-coupled types used to handle liquid components of industrial processes, industrial waste, and for such pumping applications as water supply, drainage and sewage handling. Specifications are included. Aurora Pump Div., The New York Air Brake Co.

INSTRUMENTS, CONTROLS

224 Boiler Feed Control — Bulletin 1003, a 12-pp catalog on boiler feed regulators, is illustrated with large application photos and detailed schematic drawings and charts. Relay and direct operation are covered. Case studies of representative boiler loads are presented to show stability of the Flowmatics in controlling feedwater. Copes-Vulcan Div., Blaw-Knox Co.

225 Instrument Panels — Power and process plants can choose instrument and control panels to meet individual specifications from six standard designs described in 16-pp Product Specification G71-7. Complete specifications are fur-

nished, as well as information on supports and mountings for tubes, wires and equipment, instrument mounting dimensions, and dimensions of standard instrument and control panels. Bailey Meter Co.

226 Instruments, Controls — Condensed Catalog 1537 offers brief application information on manufacturer's line of instruments. Fully illustrated, covers draft and pressure instruments, flow meters, liquid levels and pressure gages, CO_2 meters, pneumatic transmitters, positioning operators, temperature instruments, boiler feedwater controls, others. Includes references to detailed literature on each type of equipment. Republic Flow Meters Co.

227 Control Fundamentals — Three important factors in combustion control — safety, efficiency and long life — are considered in detail in 16-pp Form EB-1-756, the first of a series. Reviews basic concepts involved in automation in combustion, or the provision of automatic means for sensing heat requirements to assure correct proportioning of fuel and air under optimum conditions. Fundamentals of controls common to all systems are covered. Cleveland Fuel Equipment Co.

228 Resistance Temperature Detectors — In 8-pp Publication 3016D are described a line of remote temperature-sensitive elements for use in indicating, recording, controlling and monitoring equipment. Operation, application and construction details of the resistance temperature detectors are presented, along with specifications and ordering tips. Instrument Div., Thomas A. Edison, Inc.

229 For Feedwater Analysis — Bulletin 148BP contains a technical discussion of manufacturer's analyzers for determination of dissolved oxygen and hydrogen in feedwater. Discusses both O and H units as to function, ranges, accuracy. Cambridge Instrument Co., Inc.

230 Cooling Controls — Bulletin 710B describes company's self-powered cooling controls for compressors, stills, solvent coolers, degreasers, oil coolers, small engines, condensers, others. Includes operational drawing and hook-up sketches. Sarco Co., Inc.

231 Easy Reading Gage—An all-hydrostatic remote reading gage for boiler water and other liquid levels is described in Catalog 500, Section CO. Pictures improved visibility, other advantages offered by this gage, explains operation. The Reliance Gauge Column Co.

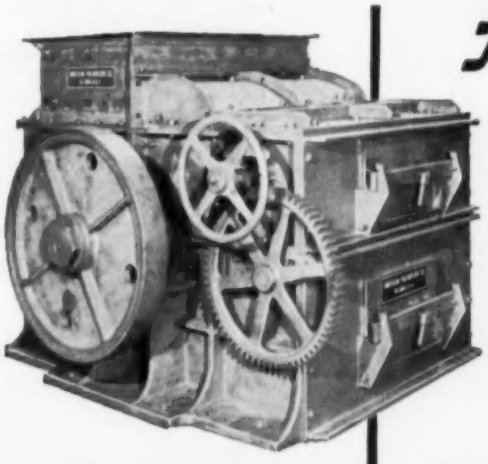
BOILERS, GENERATORS

232 Water Tube Boilers — This 12-pp catalog describes packaged water tube boilers, in capacities from 8000 to 50,000 lb per hour. Interesting as well as informative, this booklet uses color and illustrations to amplify text. Gives complete data and dimensions for boilers designed for firing oil or gas or both. Superior Combustion Industries, Inc.

233 Shop Assembled Boiler — Sixteen-pp Bulletin G-76 completely describes and illustrates company's Type FM water-tube integral-furnace boiler, made in standard sizes from 2900 to 28,000 lb of steam per hr, pressure to 250 psi. The Babcock & Wilcox Co.

234 Hot Water Boilers — This 20-pp brochure describes and illustrates design, construction, advantages and econo-

BETTER COAL CRUSHING CONTROL BECAUSE IT'S BUILT BETTER . . .



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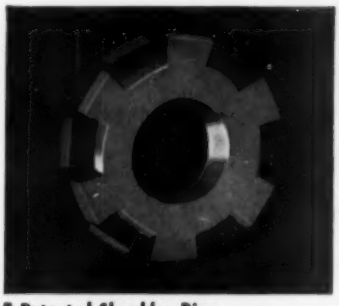

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American-originated feature that splits coal instead of smashing it—for uniform sizing, minimum fines. Result: Americans run at slow speeds, with savings in power and maintenance. No cams, shear pins, toggles.

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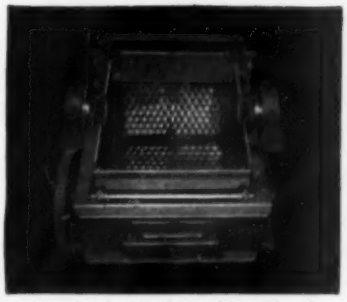
Bearing pedestals are cast integrally with lower side frames. Sectional design for easy dismantling . . . abutting joints accurately machined and bolted together for dust-tight fit.



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All adjustments external—even with crusher in motion. Rotor easily reached by removing top section. Rings readily reversed or replaced. Liners quickly reached, too, for periodical inspection.

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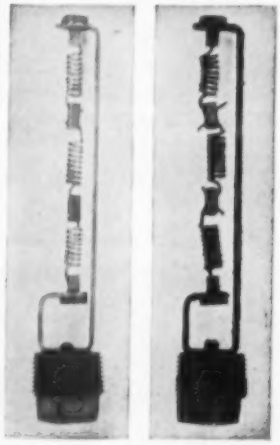
Return line corrosion is one of the most critical problems in maintaining economical, efficient power plant operation.

Bird-Archer Amine Treatment is an easy, effective and economical way to eliminate corrosion troubles. Amines raise the pH value of the return condensate to the point whereby the corrosion potential is negative. In addition, amines provide a surface protection for the metal itself which further inhibits corrosion. In scores of plants, Bird-Archer Amine Treatment is paying a profit on its cost through savings in piping replacement and maintenance work.

To demonstrate what corrosion can do in steam and condensate return lines, we show here "before" and "after" unretouched photographs of NDHA Corrosion Testers. This is a test* developed by the American Society for Testing Materials in cooperation with the National District Heating Association. Bird-Archer supplies and analyzes these testers. Photo at left shows a Tester before installation. Photo at right shows a Tester after it had been installed for 60 days in the return line. (*Standard Method of Corrosivity Test of Industrial Water, NDHA Method, ASTM Designation 935-49.)



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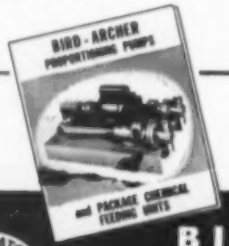

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mies of the C-E La Mont controlled circulation hot water boiler for supplying high pressure, high temperature water for heating systems and process applications. Combustion Engineering, Inc.

235 Steam Generators — Bulletin 55-1, 22-pp, describes company's products and services, including not only steam generators but also custom metal fabrication. There are many photos of boilers in various stages of assembly. Engineering drawings of boilers producing up to 500,000 lb of steam per hr on standard fuels are included, as well as illustrations of units for waste heat application and those designed to utilize refuse for fuels — wood chips, coffee grounds. The Wickes Boiler Co.

236 Steam Generators — Illustrated Bulletin SB43, 20 pp, describes company's VL factory assembled generators combining 2-drum water-type boiler, integral water cooled furnace, brick work, insulation and steel casing. A large cutaway illustration shows design details, and gas travel. Erie City Iron Works.

Do any of these catalogs answer your operating or maintenance needs? Let us know by circling the number of the catalog on the post card provided on pages 123–124. We'll do the rest!

237 Improved Steam Generator — Bulletin 2000, 28 pp, explains advance design features that distinguish this manufacturer's generator from other unit steam generators. Describes and illustrates engineering differences of component features. Also shows how these components are constructed, assembled and tested. Another section gives data and dimensions for the units. Preferred Utilities Mfg. Corp.

238 Standard Generators — Bulletin B-55-4 describes company's SC economy series of standard steam generators designed to reduce steam costs for industrial plants. Pre-engineered, standardized steam generators offered in nine sizes, with capacities of from 50,000 to 150,000 lb per hour are described, and schematic and cutaway drawings of design features are included. Foster Wheeler Corp.

239 Packaged Generators — Bulletin MH 3-54, 14-pp, gives detailed coverage to company's Type MH packaged water tube steam generators which are furnished for oil or gas firing or both, with automatic, semi-automatic, or manual controls. Included are: cutaway illustrations, installation photos, tube arrangement layouts, construction details, auxiliary equipment, dimensions. Union Iron Works.

WATER CONDITIONING

240 pH and Chlorine Control — The 12th edition of company's handbook "Modern pH and Chlorine Control," 100-pp, incorporating theory and practice of colorimetric analysis, serves as a reference for quantitative determination of pH, chlorine, phosphate, nitrite, sulfate, hardness and other tests. Slide comparators and complete test kits are illustrated. In addition to standard pH determinations, methods are outlined for quantitative analyses of phosphate, calcium, magnesium, silica nitrate hardness. Available to qualified power engineers. W. A. Taylor Co.

241 Ion Exchangers — Sixteen-pp Bulletin 1960-C, on ion exchangers, discusses the principles of cation and anion exchange, and the practical operation of ion exchangers. General properties of company's ion exchange materials are given. A chapter is devoted to design features of manufacturer's ion exchange equipment. Installations of these exchangers are illustrated. Infilco Inc.

242 For Boiler Protection — Scav-Ox, a 35 per cent hydrazine solution for removing dissolved oxygen from boiler feedwater, is described in this 16-pp illustrated booklet. It covers in detail the use of the solution for protecting low, medium and high pressure boilers, discussing determination of dosage, recommended methods of application, testing methods for hydrazine, and properties and handling of the material. Comprehensive operating data given. Olin Mathieson Chemical Corp.

243 Steam System Treatment — This bulletin on Coravol for prevention of corrosion explains theory of corrosion, application of organic amines to steam systems (Coravol process) and presents case histories of use in different types of plants and industries. Coravol is part of a complete technical service providing chemical formulas for treatment of water, steam, brine, fuel. Western Chemical Co.

244 Corrosion Treatment — "Corrosion Protection of Steam and Condensate Return Systems" is a folder on amine treatment for boiler and condensate systems. This treatment is described as affording surface protection of the metal as well as raising the pH value of the condensate. The Bird-Archer Co.

245 Feedwater Treatment — Process Bulletin B1, "Treatment of Boiler Feedwater by Direct, or Internal Method," discusses advantages of direct treatment, as a complete treating program or as a supplement to external systems. Explains why direct treatment is convenient, economical. National Aluminate Corp.

246 Water Treatment — Bulletin 5000, 24 pp, explains the reasons for boiler water treatment and tells services offered by company in providing formulations for individual plant requirements. Covers pretreatment, internal treatment, treatment application, blow-down adjustment, test control. Dearborn Chemical Co.

247 Feed Water Deoxygenation — The advantages of chemical deoxygenation of boiler feed water with an aqueous solution of hydrazine are described in 12-pp Bulletin BW 5. How hydrazine serves to maintain boiler in cleanest possible condition, reducing iron oxide scale to a magnetic oxide, is fully detailed, and such considerations as economy and operation, handling precautions, storage are covered. Fairmount Chemical Co., Inc.

REFRACTORIES, INSULATIONS

248 Refractory Cement — Heavy duty brick bonding and patching mortar is described in this 8-pp illustrated color folder. Includes success stories concerning the product's application in high temperature work and in the protection of equipment against slag, fly ash and gases. Refractory and Insulation Corp.

249 Refractory Concrete — Basic information on recommended practice for mixing and placing refractory concrete, used in the metal, power, ceramic, and

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petroleum refining industry as a material to withstand service temp to 2000 F or more, is presented in this 16-pp manual. Sections are devoted to special properties of refractory concrete, aggregates, refractory insulating concrete, and structural design. Universal Atlas Cement Co.

250 Refractory Castable — Bulletin R-40 describes use of Kaocrete-32, a high temperature refractory castable, in boiler ashpits. A discussion of various methods of ash removal, along with maintenance problems peculiar to each, is presented. Four typical installations are detailed. Refractories Div., The Babcock & Wilcox Co.

251 Insulations, Refractories — This 20-pp catalog features thermal insulations and refractories for general industrial applications. Organized for quick reference, catalog provides information on composition, physical and thermal properties and sizes of the various products. Lists chief advantages, covers materials for efficient control of temperatures from − 400 F to 3000 F. Johns-Manville.

COAL, ASH HANDLING

252 Tractor Shovel — The engineering, design and production stories of company's HD-11G tractor shovel are pictorially presented in 8-pp Catalog MS-460. Includes specifications and describes various features which mean easier servicing for less time-down and greater operator comfort. Allis-Chalmers Mfg. Co.

253 Coal Crusher — Company's WC and WS series rolling ring coal crushers are described in Bulletin 154. Emphasizes special construction elements that mean greater coal reduction at lower operating costs. Cross section illustration shows both feeding and crushing action incorporated and tables give capacities, speeds, and dimensions. American Pulverizer Co.

254 Improved Crushers — Bulletin 12-C, 16-pp, describes company's line of crushers for reducing coal, coke, glass cullet, gypsum, lime, metal turning, sugar, sulphur and similar lump materials. Covers Knittel ring type crushers, two-stage double-roll crushers, single-roll crushers, and double-roll crushers. Photos, dimensional drawings and full specifications are included. Stephens-Adamson Mfg. Co.

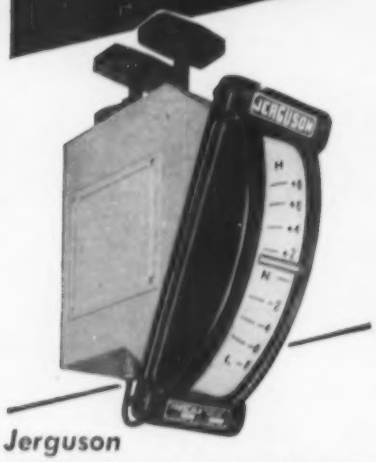
255 Why Liquid Diffusion — What liquid diffusion can do for power plants is explained in Form B, which tells how liquid diffusion compounds work and gives four practical applications. These include dust control in coal handling, fly-ash control, coal storage pile treatment and boiler cleaning. Johnson-March Corp.

FUEL BURNING EQUIPMENT

256 Oil and Gas Burners — Bulletin OB-53, 28 pp, gives principles of selection and application of oil or gas burners, or a combination of both for standard and wide capacity range operation, together with air registers and fuel oil heating and pumping sets. Conversion table shows approximate relationships between quantity of oil burned, boiler capacity and air required for combustion. The Engineer Co.

257 For Burning Refuse Fuel — This 8-pp bulletin describes refuse fuel burning equipment, including a pneumatic refuse fuel distributor which spreads refuse fuels such as bark, wood chips, and bagasse uniformly over the grate surface. Discusses

Now you can Have Your Gages Face UP or DOWN



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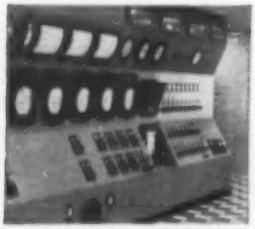

Truscale Gage inclined downward on control panel at Florida Power Corp.

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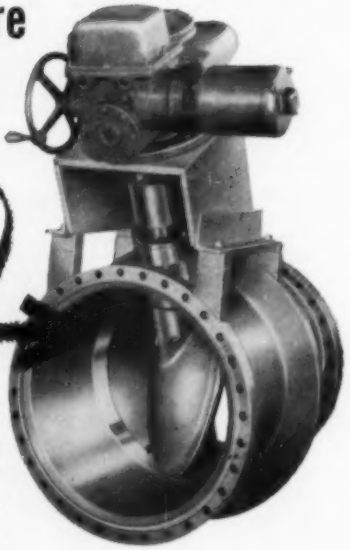

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construction features of various components. Riley Stoker Corp.

258 Steam Atomizing Oil Burners — Sixteen-pp illustrated Bulletin 21 describes steam atomizing oil burners and auxiliary equipment for use with heavy oil or tar in boilers, stills, dryers and other furnaces where steam or compressed air is available for atomizing the oil. Includes information on furnace design and construction. National Airoil Burner Co., Inc.

PACKINGS, SEALS

259 Packings and Gaskets — Catalog P-100C, 32 pp, covers 95 most popular packings and gaskets in company's line, furnishing details of construction, service recommendations and size information. Includes charts showing applications. Packing Div., Raybestos-Manhattan, Inc.

260 Mechanical Packings — Featured in 24-pp Catalog 56 are several recent packing developments including the multi-purpose Bel-Vee V-Ring packings, the long wearing criss-cross Braid packing series, twisted foil packings for oil and distillate temperatures to 1000 F, and an Inconel-wire reinforced plastic packing for valves handling superheated steam at temperatures up to 800 C. Packings for every industrial application are covered and a recommendation chart is included. The Belmont Packing & Rubber Co.

TUBING AND ACCESSORIES

261 Rotary Tube Cleaners — Bulletin R-105 presents air and water driven rotary tube cleaners and cleaner accessories. Illustrates several models and heads. Roto Div., Elliott Co.

262 Heat Exchanger Tubing — Cited in this 30-pp catalog are typical cases where cupro-nickel or Monel tubing installed in heat exchangers resulted in substantial savings and better efficiency through longer tube life. Describes applications of this tubing in various instances where unusual water conditions, as to pollution, excessive turbulence, temperature and the like, required such tubing. The International Nickel Co., Inc.

263 Life Extension for Condenser Tubes — The 32-pp current edition of this booklet reports on research into the causes of corrosion and means of combating them, as well as the choice of condenser tube materials. Points out that Admiralty metal, long a standard for power plant condenser tubes, works satisfactorily in most installations, but other alloys may be necessary in others. Revere Copper and Brass, Inc.

264 Tube Expanders — Catalog 88, 119-pp, is full of detailed information about tube expanders and associated tools used for tube rolling. Profusely illustrated, catalog provides information relative to boilers, condensers, evaporators or miscellaneous heat exchangers. Special sections are devoted to expanders, accessories, measuring instruments, rollers, extensions and drives. Each type of equipment is fully described, applications are listed, and tables of engineering data included. Also covers tube expansion methods, tool maintenance, expansion calculations and charts giving sizes. Thomas C. Wilson, Inc.

OTHER EQUIPMENT

265 Product Guide — Manufacturing facilities for company's line of steam

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you have any of these troubles:

* **1. SCALE, CORROSION, or FOAMING** *in your boiler operation.*

2. RUST and CORROSION *in your steam and condensate lines.*

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4. CORROSION or SCALE *in your hot or cold water tank and lines.*

5. RUST and CORROSION *in your brine or sweet water system.*

6. SCALE *in pumps, water jackets, compressors, coils, lines, or equipment.*

7. SLUDGE and MOISTURE *in your fuel oil supply.*

8. SOOT DEPOSITS *in your furnace combustion areas.*

then let WESTERN prove to you how a specific treatment applied to your specific problem can restore and maintain efficiency and economy in your use of water, steam and fuel. Check the number or numbers of the problems you have in the coupon below. Get full information.

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turbines, turbine generators, ship propulsion units, feed pumps, centrifugal compressors, blowers, centrifugal pumps, reduction gear, and other products are described in this profusely illustrated 50-pp catalog. Photos show manufacturing procedure. De Laval Steam Turbine Co.

266 Burning Bituminous Coal — This 24-pp illustrated booklet is a compilation of numerous actual case histories of industrial plants and institutions which burn bituminous coal "the modern way." Stressing operating economy achieved, these case histories show problems overcome, equipment used, and savings realized. Bituminous Coal Institute.

267 Turbine Speed Control — Thirty-pp wire-bound Bulletin H-21 is titled "Fundamentals of Turbine Speed Control." It is an elaborately illustrated, educational booklet intended to clarify operation of common types of automatic speed control for steam turbines. An introductory section covers general fundamentals of automatic control systems, and includes a key to control terminology. Simplified diagrams show operating principles of actual control systems. Elliott Co.

Bulletins reviewed here are offered primarily for qualified power engineers. Manufacturers may withhold literature from persons who do not state their job title and company. Some manufacturers also prefer not to send literature to those in foreign countries in which they have no sales representatives.

268 Technical Refrigeration — Twelve-pp Bulletin 754 covers a complete line of environmental testing and processing equipment. Provides illustrations and specifications on recently redesigned altitude, humidity, low temperature and prefabricated test chambers as well as specialized testing equipment. Includes helpful engineering data. Bowser, Inc.

269 Heavy Duty Fans — Eight-pp Bulletin 4824 describes new Airfoil centrifugal fans for heavy duty industrial applications. Discusses performance features and construction details of the fans. Text is supplemented with photos and drawings of wheel, housing, bearing, shaft. Several possible volume control methods that can be used with these fans are described and evaluated. Brake horsepower curves for four volume control methods are included. American Blower Corp.

270 Bearing Lubrication — Vol. XL, No. 10 of this company's Lubrication magazine provides an excellent 12-pp article on industrial bearing lubrication. Illustrated with photos and drawings, text covers such subjects as bearing design; bearing surfaces; bearing overhaul; aspects of lubrication, including factors involved, in choice of turbine oils and diesel lubricants, and the deleterious effects of moisture; and the life expectancy of bearing lubricants. The Texas Co.

271 Corrosion Control — Treatment of industrial equipment to control corrosion cannot be a hit-and-miss proposition cautions this 6-pp folder. Examples are given of optimum control measures that may avoid costly, unsound treatment

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pressure
reducing
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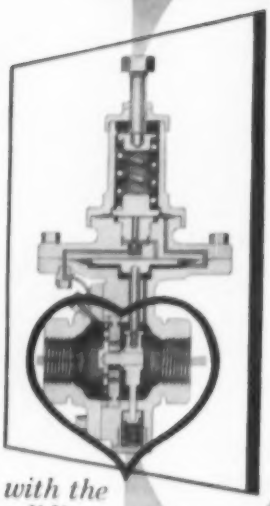

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Compensates for changes in inlet pressures and downstream demands

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procedures, including minor physical or operating changes. Hall Laboratories, Inc.

272 Corrosion, Abrasion Control — Modern practices and products for the positive protection of metal equipment from the effects of corrosion and abrasion are described in this 16-pp bulletin. Covers factory and field application of rubber or synthetic linings to metal parts or products, and maintenance coatings available for application by plant personnel. Goodall Rubber Co.

273 Sectional Condenser — Bulletin 131 shows benefits of sectional-design refrigeration condensers for 100 to 240 tons refrigeration capacity and explains their functions with diagrams and installation photos. A cutaway shows component parts. Niagara Blower Co.

274 Preheating Combustion Air — This well-illustrated 36-pp booklet explains fuel savings and increased performance made possible by using waste heat in flue gases to preheat incoming combustion air. Also covers increased boiler output, ability to use lower grade fuels, other advantages afforded. Booklet contrasts regenerative with recuperative preheaters; explains operating principle and structural details of the Ljungstrom air preheater. Applications for other than power boilers are also covered. Air Preheater Corp.

275 Steam Condensers — Advantages and features of company's line of steam condensers are detailed in this 24-pp catalog which pictures actual installations in typical power plants. Design data and an engineering section providing information on heat transfer rates, pressure drop, and other factors are included. Other sections cover air removal equipment, maintenance, and steam condenser specialties. Condenser Service & Engineering Co., Inc.

276 Steam Turbines — The advantages of company's solid wheel turbines, axial flow turbines, single stage and multistage, are outlined in illustrated Bulletin S-140. Describes various models in their line and includes application photos. The Terry Steam Turbine Co.

277 Feedwater Heaters — Open-Coil, tray-type feedwater heaters and purifiers of both deaerating and nondeaerating type are presented in 12-pp Bulletin 117-A. Construction and operational features of the heaters are explained and illustrated, and more than a dozen available models are pictured along with application suggestions. They cover capacities from 3000 to 300,000 lb per hour. Stickle Steam Specialties Co.

278 Technical Refrigeration — Twelve-pp Bulletin 754 covers a complete line of environmental testing and processing equipment. Provides illustrations and specifications on recently redesigned altitude, humidity, low temperature and prefabricated test chambers as well as specialized testing equipment. Includes helpful engineering data. Bowser, Inc.

279 Versatile Industrial Oil — Described in 20-pp Form AD 4078 is an all-purpose oil offering protection for a wide range of industrial equipment, and available in 15 viscosity grades. Discusses six major characteristics of the oil; explains and pictures its use in hydraulic systems, speed reducers, air compressors, electric motors, hydraulic turbines, bearing systems, etc. A chart shows grades available, uses, properties. Standard Oil Co. (Ind.)

Improved Operation

of literally hundreds of mechanical products has been effected with Acco Tru-Lay *flexible* PUSH-PULL Controls

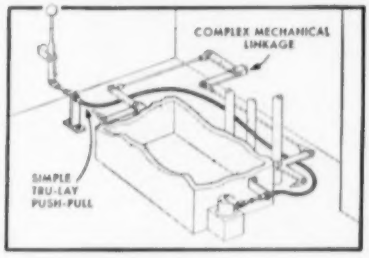
Tru-Lay Push-Pull Controls provide POSITIVE REMOTE-ACTION over long or short distances . . . with fixed or movable anchorages . . . for light loads or loads up to 1,000 lbs., and these units are frequently and successfully used in conjunction with Electric, Hydraulic and Air Controls.

Flexibility makes it possible to snake around obstructions . . . simplifies installation . . . reduces the number of working parts.

Advantages of Tru-Lay Push-Pull flexibility and simplicity are pictured below

Simplicity vs Complexity

Compare the TRU-LAY PUSH-PULL cable in illustration with the mechanical linkage. PUSH-PULLS are simple, have but one moving part, are noiseless and give lifetime service accuracy. Linkages are complex, made of many parts; they wear at many points. Their use brings increased backlash, lost accuracy and vibration rattles.



Positive Remote-Action and Flexibility, together with Precision and Long Life, explain why TRU-LAY PUSH-PULLS serve designers and users equally well in improving machine operations, whether the application is on such severe service jobs as Bulldozers, Power Shovels and Steel Mill Machinery, or on such light duty work as Photographic Equipment, X-Ray or Business Machines.

Immunity to Vibration makes these TRU-LAY PUSH-PULLS ideal as Remote Controls on shakers and other vibratory products.

Complete Protection Against Dirt and Moisture is a big factor in the use of this unit on machinery in Coal Mines, Cement and Steel Mills, Oil Fields and in many other industries.

Corrosion-Resistance of the unit, plated or with Stainless Steel construction as required by the use, has led to many applications in the Marine Field . . . salt water or fresh. Supplied with a rubber cover the unit operates effectively even when the conduit is COMPLETELY IMMERSED in water.

Lubrication of the inner member and conduit are for life.

Temperatures as low as −70°F will not hinder the proper operation of this unit, and it is thoroughly effective even in the extreme high temperatures encountered on Jet Engine, Furnace Door and Glass Furnace Damper control applications.

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EQUIPMENT NEWS

continued from page 56

30—INSTRUMENT for accurate recording, indicating of speed

Reported to measure and record speed with an accuracy of ± 0.1 per cent of measured speed, this recorder is for use with company's d-c tachometer generators. It can be calibrated in rpm, fpm or other units. According to manufacturer, the instrument's high accuracy is accomplished by measuring difference between tachometer voltage and a voltage from a precision reference contained in the instrument, expanding the instrument scale. A multi-position switch is used to change value of the reference voltage in steps, resulting in a different degree of expansion for the instrument.

It is explained that standard speed recorders with ranges of 0–1000 rpm have an accuracy of ± 0.25 per cent of span. Using this recorder, the total span is divided into 10 steps: 0–100, 100–200, and so on to 900–1000. Each step covers the entire scale and has an accuracy of ± 0.25 per cent, it is noted, but the accuracy based on the 0–100 span would be $\frac{1}{10}$ of this value, or 0.025 per cent. Company says there is an additional error (not more than 0.1 per cent) from the reference voltage and precision resistors, plus usual tachometer errors, but the end result is a highly accurate system with improved readability. Bulletin GEC-1377 gives further information. General Electric Co.

31—CONTROL VALVES for high speed applications

Hi-Speed Inlines are announced as high flow capacity, instant-action, poppet-type control valves. They are designed for use on large brakes, clutches and other devices, especially on high speed applications. They provide almost instantaneous response due to short poppet travel, says manufacturer, and this fast response provides shorter machine cycle time and results in increased work output. Other advantages cited are more accurate cuts on high speed cut-offs, less brake and clutch slip, faster machine set-up and improved operating safety because of minimum machine drift.

Simple in construction, these valves have only three moving parts. The air-cushioned poppet is operated by a solenoid pilot. Valve bodies are cast Navy M bronze, moving parts are stainless steel. The valves are offered with integral pilots or for remote pilot operation in both two- and three-way types, normally open or normally closed. Working pressures range from 10 to 200 psi, in 1 to 1 $\frac{1}{2}$-in. NPT sizes. Valvair Corp.

32—PUSHBUTTON SWITCH is space-saving lighted type

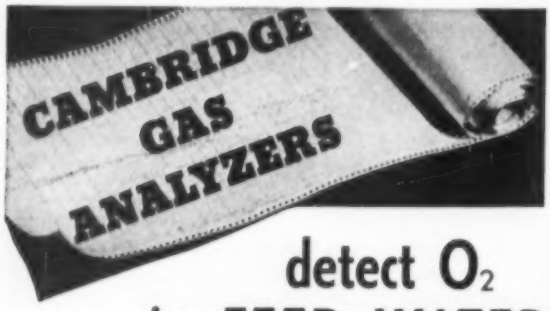
The 52PB51-T2 can be mounted on 1-in. centers, both horizontally and vertically, and requires only 2$\frac{1}{8}$ in. below its mounting panel. It has snap-action and comparatively high force differential to help prevent accidental actuations. By combining indicator light and switch in one compact assembly, these units cut panel space requirements in half, it is noted. Two subminiature single-pole double-throw basic switching elements offer versatility of circuitry.

In the new switch, the indicator lamp socket is fastened to the outer body of the switch and does not move when the button is pushed. This increases lamp life, according to manufacturer, since the lamp is not subjected to shocks from button actuation. Terminals of the indicator light are separate from those of the switch, allowing indicator light to operate on any circuit desired. The translucent buttons come in many sizes, shapes and colors. Special incandescent lamps are available for the switch in 6, 12 or 28 v. Use of suitable voltage step-down permits these lamps to be operated on 115-v power. Micro Switch Div., Minneapolis-Honeywell Regulator Co.

33—PNEUMATIC DRIVE UNITS for positioning control devices

This line of totally enclosed pneumatic drive units may be adjusted with linear, square, or square root characteristics, or field characterized for special applications. It is designed to position butterfly valves, control valves, dampers, louvers, rheostats, vanes and variable-speed drives by remote automatic or manual pneumatic signals having a range of 0 to 20 psig.

The drive unit combines positioner, four-way valve, power piston and feedback cam into one integrated, compact system. In the pneumatic circuit, the positioner supplies air pressure to operate the valve, which is in balance when feedback position balances pneumatic demand. Positioner output is then stabilized at about 9 psig, null-balance point of the valve. Any deviation from



detect O_2
in FEED WATER

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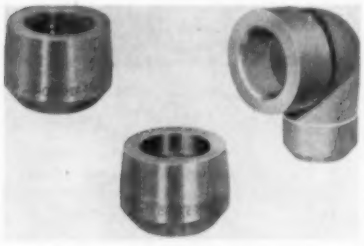
9 psig determines both magnitude and direction of drive-unit movement by exhausting one side of power piston and increasing air loading on other side.

When in manual position, an integral transfer valve shuts off the main air supply to both four-way valve and positioner, and exhausts both sides of the power piston. The torque shaft may then be directly positioned by a lever or handwheel, leaving pneumatic parts easily accessible. Five models cover a range of sizes, torque ratings. All have 90-deg angular rotation, are equipped for manual operation, and consume 1.5 scfm of air at 80 psig. Copes-Vulcan Div., Blaw-Knox Co.

Described on these pages are new and improved products. Use Reader Service Cards on pages 123–124 to ask for more information on them. Just circle the item numbers of all the products in which you are interested.

34—OUTLET FITTINGS are easily installed connections

W-S Couplets are easy-to-install branch outlet connections for pipelines, tanks and pressure vessels. The W-S Couplet was designed to function as a universal outlet connection. On most applications the fittings are used without modification. Where attachment is to be made to a small diameter pipe, the fitting is



modified by contouring the welding end with an acetylene torch to mate with the curvature of the pipe diameter. Couplets are made with extra length and heavier wall to permit contouring without detriment to strength of fitting, weld or end.

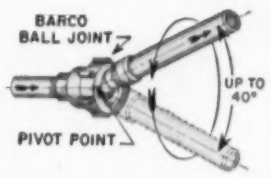
W-S Couplets come in sizes ¼ through 2 in. with screw-end or socket-welding end connections. They are also available in 90-deg elbows. They can be had in forged carbon steel (ASTM A-105, Grade 2), 3000-lb WOG class screw-end type and schedule 40–80 socket-welding type. Bulletin CP-1-57 gives data. W-S Fittings Div., H. K. Porter Co., Inc.

35—GAS DENSITY BALANCE utilizes null balance principle

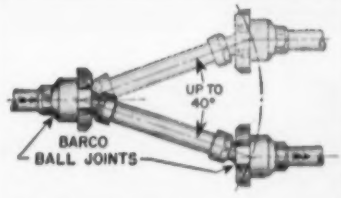
Typical applications of the 3A Gas Density Balance include: continuous density measurements of hydrocarbon process streams; continuous hydrogen readings on H_2 blanketed generators; other uses in which specific gravity or density provides an index to gas stream properties. The 3A measures the density of a sample gas by a null balance principle. A small dumbbell is supported on

How Barco Ball Joints Solve Piping Flexibility Problems

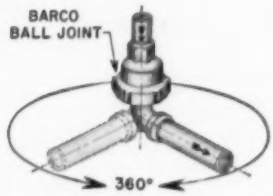
FOR TEMPERATURES UP TO 1000° TO 1200°F.



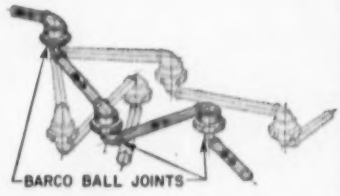
ONE JOINT—Provides for angular motion or positioning of piping in any plane. (Also see below.)



TWO JOINTS—This arrangement provides for piping alignment or simple flexible connection.



ONE JOINT—Allows for full 360° swivel or swing motion, in addition to angular movement shown above.



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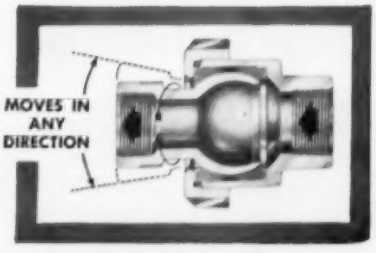

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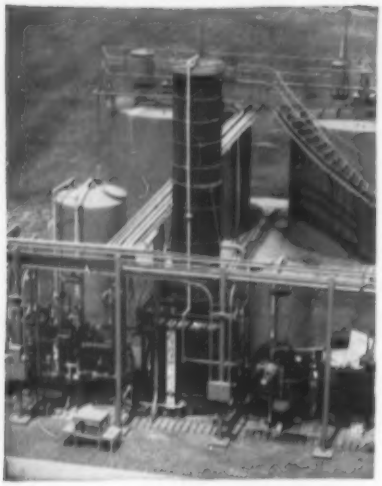

"SILICA: 0.003 PPM, OTHER SOLIDS UNMEASURABLE..."

With some doubt as to the outcome, the de-ionization units pictured above were installed outdoors at a Texas power and light company, to replace evaporation equipment as a means of purifying feed water for a high-pressure boiler. After three years, results far exceeded guarantee and expectations. From raw water containing 27 ppm of silica and dissolved solids totaling 565 ppm, the quality of the effluent is reported as: "Silica, zero to 0.005 ppm, average 0.003 ppm. Other solids are unmeasurable."—This is a good example of what modern ILLCO-WAY ionXchange can accomplish.

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The particular plant shown above consists of a cation exchanger, an aerator, and a mixed-bed deionizer. The large tanks in the background hold a supply of regenerants. Operation is manual throughout, a preference of the purchaser. *Results have proved even more economical than expected.*

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a horizontal quartz fiber — one of its balls being punctured so as to avoid buoyancy effects. The other ball tends to rise or dip as the density of the gas increases or decreases. Thus the dumbbell experiences a rotational force about the quartz fiber as it responds to density changes. The magnitude of this force is proportional to density of sample gas.

Metal coated for conductivity, the dumbbell is held in place by an electrostatic force established with adjacent electrodes held at a fixed potential. When the dumbbell rotates, it is restored to its null position by applying proper electrostatic potential to its surface. Magnitude of balancing potential necessary is proportional to the sample's density. The balancing potential is used to operate a meter on the door of the balance, or on an external indicator or recorder. A 95 per cent response is obtained within a minute, manufacturer claims, and sensitivity is ½ per cent of full-scale. Bulletin 118-A gives details. Arnold O. Beckman, Inc.

36—SWITCHBOARD EQUIPMENT is metal enclosed

This metal-enclosed outdoor switchboard equipment — similar in appearance to metal-clad outdoor switchgear — eliminates need to allot control building space for switchboards, and permits units to be located near apparatus they help to protect, thereby reducing

amount of wiring needed. Space is provided at front of enclosure for protection and convenience of servicing personnel, allowing maintenance to be carried on during inclement weather. In a line of several units, side sheets are eliminated, and space becomes a walk-through aisle. Enclosures have internal illumination, heaters, outlets and ventilation. General Electric Co.

37—SLIMICIDE is now available in a liquid form

Nalco 201, is a chlorinated phenolic type slime control agent described as a highly stable liquid material. Previously this company has supplied chlorinated phenolic type treatments only in ball briquette form. The new product is suggested for general microbiological control in pulp and paper mills and in recirculating cooling water systems, where it is said to be an effective control for both bacteria and fungi. In addition to the active killing ingredient, Nalco 201 contains penetrating and dispersing agents. These additives increase the killing power of the treatment, it is noted. Nalco 201 is reported to break up protective slime masses and permit the killing ingredient to make intimate contact with the slime forming microorganism. National Aluminate Corp.

38—GASKET CUTTER features hexagonal-shaped bar

The B Set Gasket Cutter, used for cutting round gaskets from asbestos, rubber, fibre or cork sheets, can also be used for precision scribing and layout work. The cutter features a hexagonal-shaped bar with a six-sided face on which to mount knife and point holders, said to assure a smooth, positive gripping surface for holders. The tool is adjustable to cut gaskets 1¼ to 22¼ in. OD. Center point and knife holders can be mounted on a bar for cutting larger gaskets. Bulletin 140 describes this cutter. The Garlock Packing Co.

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Agency—Hanson & Stevens, Inc.
FOSTER CO., BENJAMIN *
Agency—Elmer P. Cook Associates
FOSTER WHEELER CORP. 42–43, 59
Agency—Marsteller, Rickard, Gebhardt & Reed, Inc.
FULLER CO. 58
Agency—O. S. Tyson & Co., Inc.

GENERAL COAL CO. 137
Agency—The Aitkin-Kynett Co.
GENERAL ELECTRIC CO. *
Agency—G. M. Basford Co.
GLOBE CO., PRODUCTS DIV. 118
Agency—Ross Llewellyn, Inc.
GOODALL RUBBER CO. *
Agency—George C. Taylor Advertising
GRAVER WATER CONDITIONING 2
Agency—Trade Method Advertising

HAGAN CHEMICALS & CONTROL, INC. 125
Agency—Ketchum, MacLeod & Grove, Inc.
HALL LABORATORIES, INC. 61
Agency—Ketchum, MacLeod & Grove, Inc.
HILLIARD CORPORATION, THE *
Agency—Mellor Advertising Agency, Inc.
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Agency—Waldie & Briggs, Inc.
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Agency—Cummings, Brand & McPherson
INFILCO INC. *
Agency—Willard C. Gregory & Co.
INTERNATIONAL NICKEL COMPANY, INC., THE 117
Agency—Marschalk & Pratt Co. Division of McCann-Erickson, Inc.

JERGUSON GAGE & VALVE 130
Agency—Ray Elliott Co.
JOHNS-MANVILLE *
Agency—J. Walter Thompson Company
JOHNSON-MARCH CORP. 28
Agency—Thomas R. Sundheim
JORDAN CORP. 132
Agency—Haehnle Corp.

KAISER ENGINEERS 31
Agency—L. C. Cole Co., Inc.
E. KEELER CO. 63
Agency—Charles E. Williams Advertising
KIRK & BLUM MFG. CO. 52
Agency—Baer, Kemble & Spicer
KOPPERS CO., INC. 111
Agency—VanSant Dugdale & Co., Inc.
KOR CORPORATION *
KULJIAN CORP. *
Agency—The Roland G. E. Ullman Org.

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Agency—Ruthrauff & Ryan, Inc.
LEAVITT MACHINE CO. *
Agency—Seth R. Martin
LESLIE CO. 51
Agency—Reid, Decker & Stocki, Inc.

MANNING, MAXWELL & MOORE, INC. 107
Agency—Fuller & Smith & Ross, Inc.
MARLEY CO., THE *
Agency—Valentine Radford Advertising
MARYLAND SHIPBUILDING & DRYDOCK CO. 60
Agency—Speed & Company, Inc.
MEAD-MORRISON DIVISION, McKIERNAN-TERRY CORP. 37
Agency—Michel-Cather, Inc.
MILTON ROY CO. 45
Agency—The Aitkin-Kynett Co.
NAGLE PUMPS, INC. *
Agency—Tri State Advertising Co., Inc.
NATIONAL AIROIL BURNER COMPANY, INC. *
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NATIONAL ALUMINATE CORPORATION 24
Agency—Armstrong Advertising Agency
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Agency—Callaway Association
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Agency—W. S. Kirkland Advertising
OLIN MATHIESON CHEMICAL CORP. 114
Agency—Doyle, Kitchen & McCormick, Inc.

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Agency—Cunningham & Walsh, Inc.
PHILADELPHIA PUMP & MACHINERY CO. 54
Agency—The Michener Co.
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Agency—W. S. Hill Co.
POWELL VALVES 62
Agency—The Ralph H. Jones Co.
PRAT-DANIEL CORP. 120
Agency—Pearsall & Schael
PREFERRED UTILITIES MFG. CORP. *
Agency—Spooner & Kriegel
PROPORTIONEERS, INC. 116
Agency—Horton, Church & Goff, Inc.

RAYBESTOS-MANHATTAN, INC. *
Agency—Gray & Rogers
REFRACTORY & INSULATION CORP. *
Agency—Spooner & Kriegel
RELIANCE GAUGE COLUMN COMPANY 32
Agency—Carr Liggett Advertising Inc.
REPUBLIC FLOW METERS CO. 20–21
Agency—Stoetzel & Associates, Inc.
REVERE COPPER & BRASS, INC. *
Agency—St. Georges & Keyes, Inc.
RIC-WIL, INC. 40
Agency—Ritchie & Sattler, Inc.
RILEY STOKER CORPORATION *
Agency—Seth R. Martin
ROCKWELL CO., W. S. 130
Agency—Spooner & Kriegel
ROSS HEAT EXCHANGER DIVISION 18–19
Agency—Harold Warner Co.
ROTO DIV. OF ELLIOTT CO. 56
Agency—Jos. Vogel & Co.

SARCO COMPANY, INC. 49
Agency—Marsteller, Rickard, Gebhardt & Reed, Inc.
SINCLAIR REFINING CO. *
Agency—Morey, Humm & Warwick, Inc.
SOCONY MOBIL OIL CO., INC. *
Agency—Compton Advertising, Inc.
SPENCE ENGINEERING CO. *
Agency—Michel-Cather, Inc.
STANDARD OIL CO. (INDIANA) 103
Agency—D'Arcy Advertising Co.
STEARNS MAGNETIC PRODUCTS *
Agency—Bert S. Gittins Advertising, Inc.
STEPHENS-ADAMSON MFG. CO. 55
Agency—Connor Associates, Inc.
STICKLE STEAM SPECIALTIES CO. *
Agency—W. H. Rohr, Jr.
STONE & WEBSTER ENGINEERING CO. 33
Agency—Harold Cabbot & Co., Inc.
STURTEVANT MILL CO. *
Agency—F. P. Walther Jr. & Associates, Inc.
SUPERIOR COMBUSTION INDUSTRIES, INC. 122
Agency—Charles H. Davis

TAYLOR & CO., W. A. *
Agency—Emery Advertising Corporation
THE TERRY STEAM TURBINE CO. 115
Agency—Gassaway Advertising Agency
TEXAS CO., THE Back Cover
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Agency—Laux Advertising, Inc.

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Agency—Harold Warner Co.
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Agency—The McCarty Co.
UNIVERSAL ATLAS CEMENT CO. 35
Agency—Batten, Barton, Durstine & Osborn, Inc.

VOGT MACHINE CO., HENRY 57
Agency—Farson, Huff & Northlich

WESTERN CHEMICAL COMPANY 131
Agency—Carter Advertising Agency, Inc.
WESTERN PRECIPITATION CORP. 140
Agency—Dozier Eastman & Co.
WICKES BOILER CO. *
Agency—Price, Tanner & Willox, Inc.
WILLIAMS GAUGE CO. *
Agency—Downing Industrial Advertising, Inc.
WILSON, INC., THOMAS C. *
Agency—Michel-Cather, Inc.
WORTHINGTON CORPORATION *
Agency—Needham, Louis & Brorby, Inc.

YARNALL-WARING COMPANY 8–9, 66
Agency—The Michener Co.

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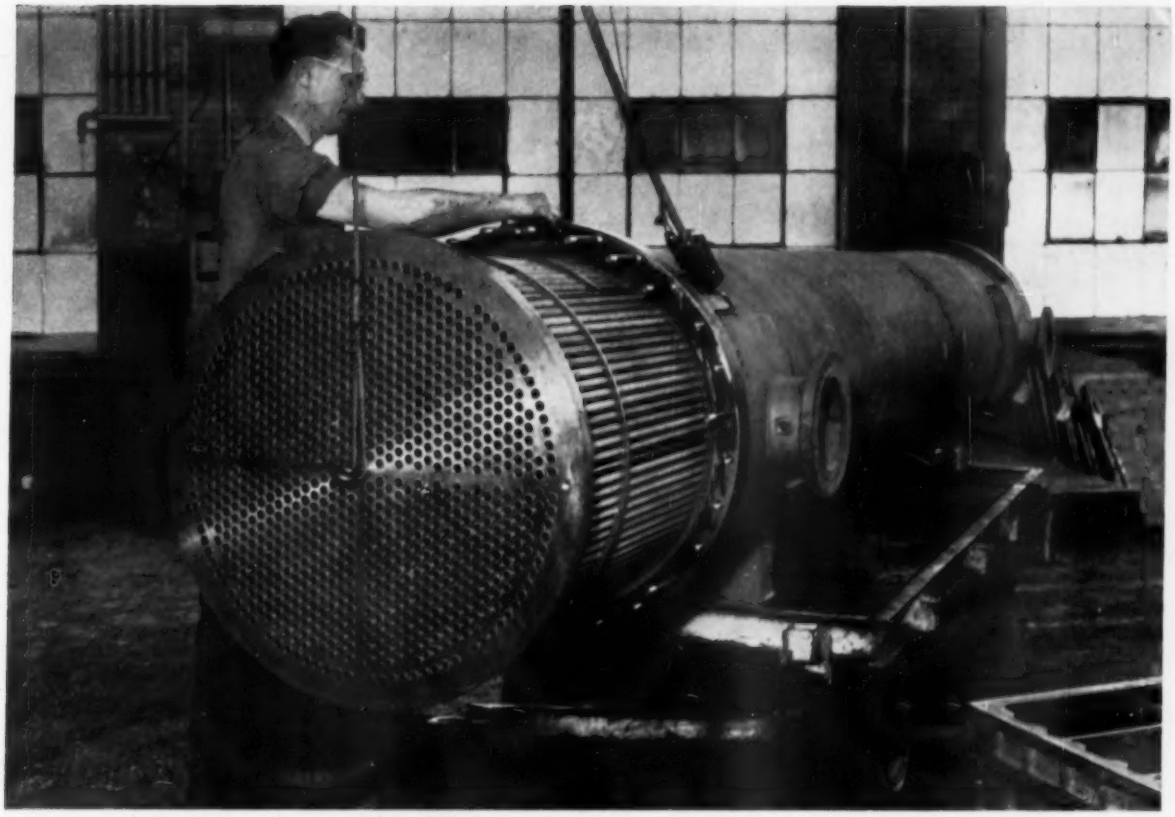


Tube bundle partially removed from shell of General Electric heat exchanger. Fixed-end tube sheet is Ambraloy-917, one of The American Brass Company's aluminum-bronze alloys. Tube sheet is 36⅜" diameter, 2" thick.

Thick, rolled circles of Anaconda Aluminum Bronze available for high-strength tube sheets

Where superior strength and corrosion resistance are required in heat-exchange applications, the use of *rolled* circles of Ambraloy-917 for the tube sheets offers appreciable savings in material cost compared to circles produced by the forging process. The American Brass Company can furnish Ambraloy-917 in rolled circles up to 5" thick, maximum diameters are governed by thickness.

Anaconda sheets, plates and circles are available in a wide range of alloys and sizes for heat-exchange service in marine and stationary-steam power plants, oil refineries and other process industries. Produced by the rolling process, they are commercially flat, accurate in dimensions and are free from the surface imperfections and porosity often prevalent in cast plates. The American Brass Company makes plates for condenser tube sheets of copper and several copper alloys in rectangular sizes up to 156 inches in width and weights up to 15,000 pounds for any shape that can be cut from such sheet. The maximum standard limits for circles are 160 inches in diameter and 11,000 pounds in weight. Half-circles can be produced up to 13,000 pounds in weight.

Special jobs. When specifications call for extremely large plates for special applications, The American Brass Company will gladly cooperate in the solution of such problems. For further information on Anaconda Condenser Tubes or Tube Sheets write: The American Brass Company, Waterbury 20, Conn.

Completed General Electric water-to-water heat exchanger for cooling the condensate recirculated through the hydrogen coolers of a 427,500-kva cross-compound turbine-generator unit. Water box cover is also Ambraloy-917, 36½" diameter and 2⅜" thick.

ANACONDA®

TUBES AND PLATES FOR CONDENSERS AND HEAT EXCHANGERS

Made by

The American Brass Company

For more data circle 579 on Post Card

New Automatic Precipitator Control by

WESTERN PRECIPITATION

offers many vital advantages...

1 LONG LIFE

This new control has indefinite life expectancy under all types of operating conditions. There are no tubes to replace, no high speed relays, counters, or timers to maintain. All circuitry consists of rugged "static" devices that have unusually long life!

2 RELIABILITY

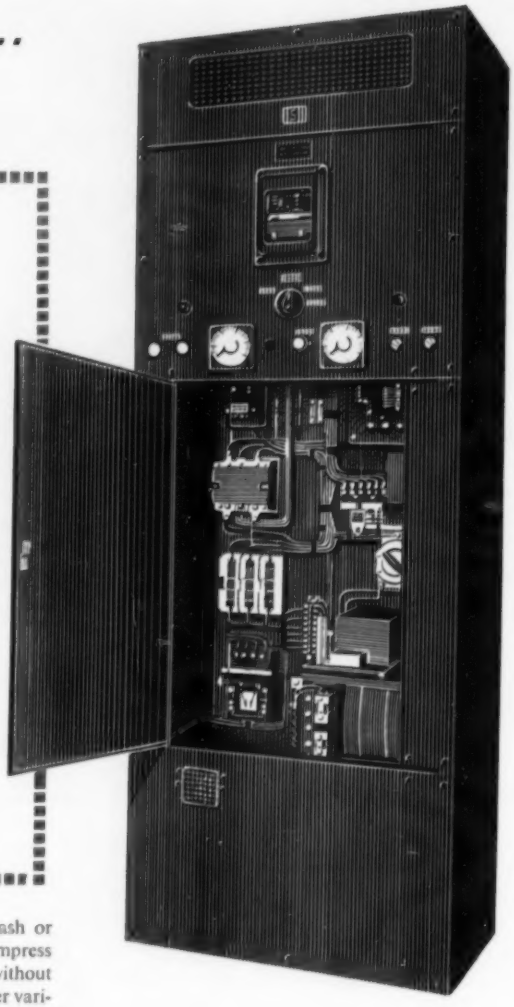
Optimum Precipitator power input is maintained regardless of operating conditions. The sensing control is simple, positive, accurate—and automatically evaluates the spark "Power Value" (intensity and frequency)—not just frequency or intensity alone.

3 STABILITY

Under short circuit, open circuit or other varying conditions, this control is completely stable and inherently trouble-free!

4 MODEST COST

Modest initial cost coupled with negligible maintenance assure optimum operating efficiency (therefore lower operating costs) throughout many years of continuous service.



WHEN using a Cottrell Precipitator for collecting dust, fume, fly ash or other suspensions from industrial gases, it is essential at all times to impress on the high voltage system the highest possible voltage and current without "flashover". Depending upon gas conditions, dust loading and other variable factors, the optimum voltage and current requirements vary widely from one minute to the next. Therefore, the vital importance of a simple, trouble-free and highly sensitive Precipitator Control is self-evident.

This new Western Precipitation Automatic Precipitator Control—*a product of the organization that has consistently led in the application of Cottrell Precipitators for industrial gas cleaning* — combines vital advantages found in no other competitive equipment. Our nearest representative will be glad to supply complete details. Or write direct!

Why not modernize your present out-dated Precipitator installation? The Western Precipitation Automatic Precipitator Control can be installed on any Cottrell unit. For further information contact our nearest office!

Western Precipitation Corporation

Designers and Manufacturers of Equipment for Collection of Suspended Material from Gases ..and Equipment for the Process Industries

Main Offices: **1029 WEST NINTH STREET, LOS ANGELES 54, CALIFORNIA**

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MULTICLONE Mechanical Collectors
CMP Combination Units
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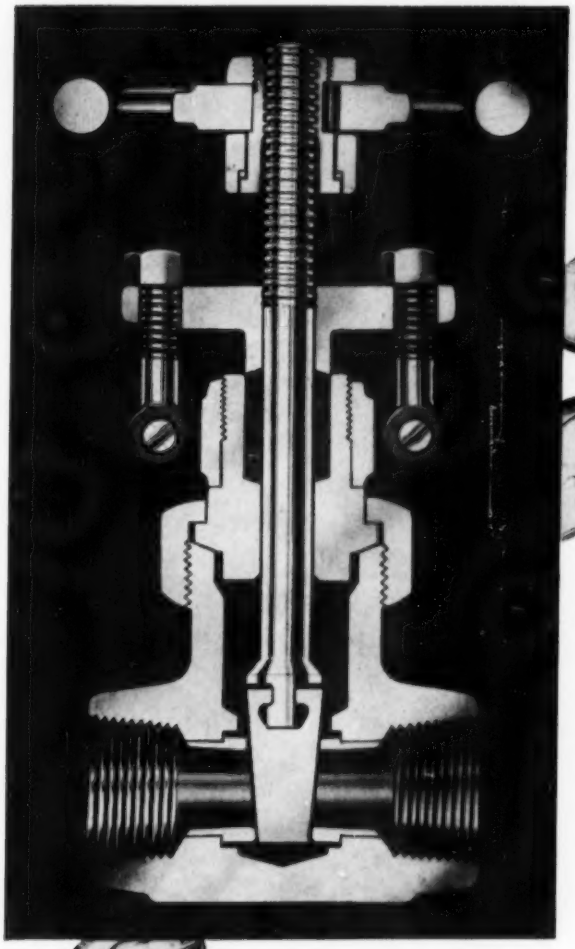

As Good as Money in Your Pocket

CHAPMAN LIST 960

Small Forged Steel Gate Valves!

In more cases . . . on more jobs . . . you'll find more Chapman List 960 valves at work than any other small forged steel valve. Such popularity must be deserved . . . and is. Chapman List 960 valves really have it.

Wedge faces are super hard. They're hardened to 800 Brinell by *Chapman's exclusive Malcomizing process.* They can't gall or seize. And the seat rings are hardened stainless steel. They're hard to wear out but, when the time comes, easily replaced. There's no full pressure repacking difficulty. No exposed threads on bolted follower of the special outside screw rising stem design. No trouble makers from top to bottom.

The time and money you save on maintenance and replacements are money in your pocket. These valves stand up long and perfectly under conditions ranging from 380 psi at 1000°F. to 2000 psi at 100°F. Of course, for higher pressures you specify Chapman List 990 valves.

Sizes for Chapman List 960 range ¼" to 2". With rising stem with yoke or with rising stem with inside screw. Bonnet joint is either gasketed or ground metal to metal, as you prefer.

They're all listed, and explained in our Catalog 10. Send for it, now.

The CHAPMAN Valve Manufacturing Co.

INDIAN ORCHARD, MASSACHUSETTS

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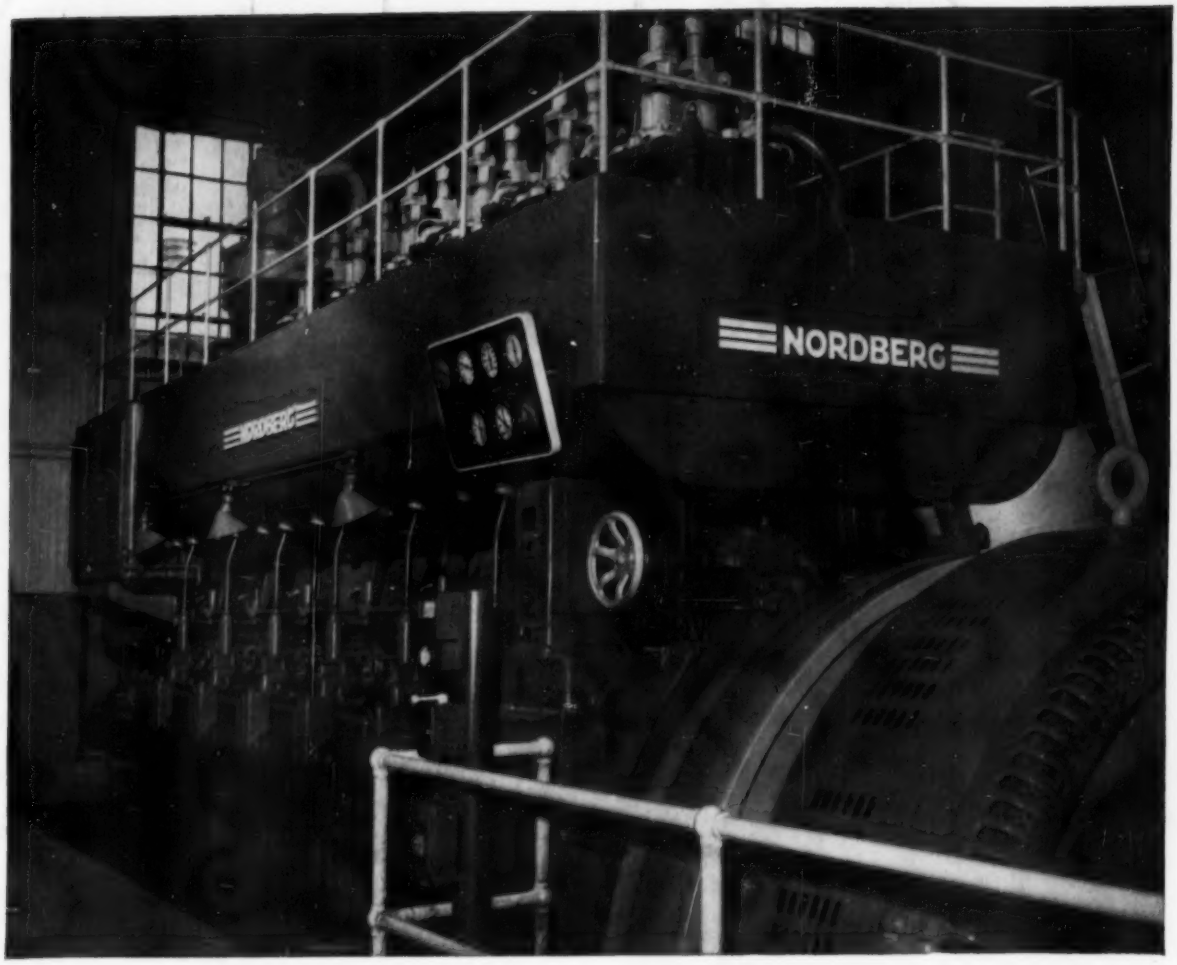

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For over twenty years more stationary diesel horsepower in the United States has been lubricated with Texaco than with any other brand.

There is a complete line of *Texaco Ursa Oils* to meet the requirements of all diesel, gas and dual-fuel engines.

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FOR ALL DIESEL, GAS AND DUAL-FUEL ENGINES

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